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Report of the Science Strategic Initiative on Climate Change (SSICC)

28 January 2010

ICES Headquarters, Copenhagen, Denmark



ICES International Council for the Exploration of the Sea

CIEM Conseil International pour l'Exploration de la Mer

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Executive Summary

The Science Strategic Initiative on Climate Change (SSICC), co-chaired by Luis Valdés (Spain) and Jürgen Alheit (Germany) met at the ICES Headquarters, Copenhagen, Denmark on 28 January 2010. This is a high level group created by Council decision at the Council's 2007 Annual Meeting, recognizing the strategic importance of ICES in being pro-active in marine scientific research related with climate change.

The report is divided into three main sections: the first section reviews the intersessional activities directly engaged with the group, the second focuses on the discussions of the ToR and the third is focussed in the analysis of opportunities related with the IPCC and conclusions after the COP-15.

Intersessionally the SSICC has promoted 4 Theme Sessions during the last ASC and two workshops. Regarding the Theme Sessions, the conveners were encouraged to prepare a report that could be turned into a contribution for the Position Paper on Climate Change. The SSICC co-chairs confirmed that the conveners accepted the commitment and contributed to some specific chapters. Two workshops were conducted in January 2010, the workshop on "How Models help us to understand Climate Change Evolution and Impacts in the Regional Oceans" [WKMCCEI], chaired by Dr. Stephanie Ponsar (Belgium), met in Brussels, Belgium on 12–14 January 2010 and was attended by 14 experts from 8 ICES countries. The Editorial Workshop for the Position Paper on Climate Change Science [EWPPCC], with Philip C. Reid (UK) as chair, met at the ICES Headquarters, Copenhagen, Denmark on 25–27 January 2010. In total 22 participants contributed to the workshop, including most of the lead authors of each chapter.

The terms of reference approved by SCICOM (Resolution 2009/2/SSGEF01) were discussed in detail. This included the review of the drafts of chapters for the ICES position paper on climate change and updates the time table until its publication. The position paper will require an extraordinary effort from the contributors to have the manuscripts in time; as a result, a new time table was prepared and discussed with the chair of Pub. Com. and SCICOM; and the position paper will be published by the end of the year. The status for ICES Symposia, workshop and theme session for the ASC, related with climate change was reviewed and it was noted that ICES is convening international symposia related with climate change and variability from 2009 up to 2012.

The ICES Science Plan 2009–2013 is now in the phase of implementation and one of the most interesting novelties is the possibility of establishing cross-cutting programmes and work under interdisciplinary approaches. Improving our understanding of climate change requires interdisciplinary collaboration and SSICC envisions the establishment of a cross-cutting programme in Climate Change as the main instrument of ICES work in climate change. Following the mandate of the Council, the SSICC has now prepared a roadmap which could serve as a basis and guide for the future of such cross-cutting programmes.

Climate change is the one of the main drivers in environmental sciences and so it is included as a programmatic activity in most international organizations coordinating marine sciences. This offers ICES great opportunities for collaboration with relevant international organizations on issues related with climate change. In this regard, the SSICC reviewed the scope of competences and objectives of some relevant international organizations and core programmes in climate change: FAO, IOC, PICES, IPCC, WCRP, IGBP, JCOS, IASC, and AOSB.

Finally the SSICC discussed the convenience for ICES to nominate some experts for consideration as Coordination Lead Authors, Lead Authors, or Review Editors for the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Penny Holliday, John Pinnergar, Svein Sundby and Ken Drinkwater were considered and they accepted the nomination. Then, the SCICOM was consulted for approval and finally it was recommended at ICES to formally nominate them as lead authors for next IPCC report.

1 Welcome

The Science Strategic Initiative on Climate Change (SSICC), co-chaired by Luis Valdés (Spain) and Jürgen Alheit (Germany) met at the ICES Headquarters, Copenhagen, Denmark on 28 January 2010. The co-chairs welcomed all participants (Annex 1). Apologies had been received from Sarah Hughes (UK), Adriaan Rijnsdorp (Netherlands) and Dave Kulka (Canada) who were unable to attend.

Luis Valdés summarised the history and main objectives of this SSICC group. He explained that the group was renamed by the SCICOM after the last ASC, from the original SGCC (Steering Group on Climate Change) to the new SSICC (Science Strategic Initiative on Climate Change). However, as the group was created in 2007 by a Council decision with a projected lifetime of 3 years, the group is completing its mandate this year, although it aspires to be reorganised as an ICES cross-cutting programme on Climate Change. To this end, one of the main objectives of this year regular meeting is to prepare a roadmap which should serve as guide of the programme on climate change.

2 Adoption of Agenda

The meeting agenda was adopted. It was based on the Terms of Reference approved by the Council (resolution 2009/2/SSGEF01) and also on the review of the intersessional activities. In addition, it was suggested to incorporate two items that were considered of importance for their relevance for the group. Both items, the nomination of experts for consideration as Coordinating Lead Authors, Lead Authors, or Review Editors for the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), and COP 15, were discussed at the end of the agenda.

3 Review of SSICC intersessional activities 2009–2010

3.1 Theme sessions on Climate change during 2009 ASC

The SSICC promoted 4 Theme Sessions (TS) during the last ASC. All were well attended and the number of contributions was as follow:

Code	Session	Papers	Posters	Total
D	Trends in chlorophyll and primary production in a warmer North Atlantic	12	3	15
E	Climate impacts on marine fishes: discovering centennial patterns and disentangling current processes	34	7	41
F	How does fishing alter marine population's and ecosystem's sensitivity to climate?	10	1	11
G	Comparative study of climate impact on coastal and continental shelf ecosystems in the ICES area: assessment and management	15	4	19

The conveners were encouraged to prepare a report of their TS that could be turned into a contribution for the Position Paper on Climate Change. The SSICC co-chairs confirmed that the conveners accepted the commitment. Most of them have contributed with some pieces of text. The reports of these four theme sessions are included as Annex 2.

The chair of SSICC informed that a positive outcome of theme session D (Trends in chlorophyll and primary production in a warmer North Atlantic) was the creation of a Working Group on Phytoplankton and Microbial Ecology [WGPME] which will be

co-chaired by William Li (Canada) and Xelu Morán (Spain). The first meeting will be hosted by the Aberdeen Marine Laboratory (3–5 March, 2010).

The SSICC was also informed that the ICES ASC 2010 price to Best Newcomer was won by Ángela M. Caballero-Alfonso (Spain), contributor of theme session E who presented the communication 'Do climate patterns explain by themselves the oscillations observed in the Blue-fin tuna (*Thunnus thynnus*) at the Western Mediterranean "almadrabas" traps catches since 1500s to 1960s?' (ICES CM 2009/ E:10).

3.2 Workshop on How Models help us to understand Climate Change Evolution and Impacts in the Regional Oceans

Models are powerful tools to help us to understand the processes and the functioning of marine ecosystems, but the results of the models are very often projected beyond their significance or are used in an inappropriate manner. Making projections about the effects of climate change on marine ecosystems is a sensible task and we must be cautious on the assumptions we make and the manner that the results are interpreted. There is a scientific need to review the state of the art in modelling the feedbacks of the ocean on climate change and also to ensure credible comparison and validation of models for predicting effects of climate change at basin and regional scales.

The Workshop on 'How Models help us to understand Climate Change Evolution and Impacts in the Regional Oceans' [WKMCCEI] (Res 2009/2/SSGEF04), chaired by Dr. Stephanie Ponsar, Belgium, met in Brussels, Belgium, 12–14 January 2010 and gather the participation of 14 experts from 8 ICES countries.

The aim of this workshop was to provide contributions on the topics that will be covered in chapter 12 of the ICES position paper on climate change "Modelling ocean climate change evolution and impacts at global to regional scales".

Key issues related to the modelling of climate change at the regional scale have been identified:

- the validation of models relies on sufficiently good and long time series of observations of the ocean state,
- a better assessment of ocean variability for e.g. ocean colour, dynamics, clouds,
- a better characterization of surface fluxes and local processes controlling the upper-mixed layer in the ocean for the last 20 years,
- a need for coupled ocean-atmosphere models at the regional scale,
- the critical role played by the initial conditions on the output of global scale models,
- the critical dependence of regional models to the output (e.g. boundary forcing) provided by the global model.

The participants were invited to give a presentation and to provide a summary of it. These summaries have been compiled to serve as a basis for the chapter draft.

3.3 Editorial Workshop for the Position paper on Climate Change

This workshop was planned as a essential step to control the quality of the scientific content of this publication. This workshop was also necessary to unify the style and to identify the points that need clarification or should be completed or expanded.

The Editorial Workshop for the Position Paper on Climate Change Science [EWPPCC], with Philip C. Reid (UK) as chair, met at the ICES Headquarters, Copenhagen, Denmark on 25–27 January 2010. In total 22 participants contributed to the workshop, including most of the lead authors of each chapter.

The terms of reference for the expert group are contained in Res. 2009/2/SSGEF:02. The meeting alternated between plenary and drafting group sessions, with small groups at times working on individual chapters. The structure, publication and guidelines for the report were agreed upon and ways of highlighting the past and future role of ICES in climate change science as well as using the ICES Data Center were addressed. The geographical area to be covered will include the North Atlantic up to the North Pole. A Foreword and 12 chapters were worked on over the three days of the meeting, along with for the Conclusions chapter, and a timetable to meet the need for publication prior to the Annual Science Meeting.

Chapter 13 'Conclusions and future research in climate change' will be prepared just after the Editorial workshop. Harald Loeng (Norway) and Ken Drinkwater (Canada) have agreed to draft the chapter. Proposed chapter headings:

- Main findings
- Important highlights from the chapters, processes etc.
- Gaps in knowledge (Prediction and risk)
- Research actions to fill gaps
- Promotion of ocean observation and modelling
- Role of ICES and suggestions on how the Council might work in the future on climate change, including the challenge of undertaking work in other areas of the ocean(s).

As a basis for the chapter, leads for Chapters 2 to 11 will provide to Harald Loeng the top five conclusions from their chapters and notes to address in summary the bullets above.

The executive summary will be written by Philip C. Reid, Jürgen Alheit and Luis Valdés and it will represent the official view of ICES on climate change.

4 Terms of Reference

4.1 Review the draft of chapters for the ICES position paper in climate change and update the time table until its publication

The position paper is progressing with difficulties and it will require an extraordinary effort from the contributors to have the manuscripts in time. Nevertheless, we are still maintaining the ASC as the horizon and the event in which this document will be delivered.

The SSICC met just after the editorial workshop, where the status of all chapters was reviewed. A list of recommendations was made and delivered to the lead author of each chapter.

It was agreed that the editors will prepare the Executive summary and that Harald Loeng and Ken Drinkwater will be the responsible for chapter 13 (more information in section 3.3).

It is intended that this ICES Position Paper, or specifically the executive summary, represents the official ICES view on climate change, and will be an official and citable

ICES product. This report will be printed and the publication of this material as a CRR will cost ca. 85 000 DKK. The cost will be covered by the SIF fund budget allocated to the SSICC and the copies will be distributed free of charge (Resolution 2009/1/SSGEF10). The publication costs as described were approved by the Bureau in its meeting of June 2009. An electronic version in PDF format will be available at the ICES web page.

An external review will be done by the Review Group of the Position Paper on Climate Change (RGPPCC), chaired by Pierre Pepin, which will meet by correspondence between January and May 2010 to:

a) Identify and distribute the draft document to external reviewers with relevant expertise and/or interest for each section of the draft document to provide a technical (scientific) assessment of the material;

b) Synthesize the comments of the external reviews, edit the document with the Executive Editor to include the recommendations, and identify sections of the documents that require special attention;

c) Distribute the document with all comments to SCICOM members who will be asked to provide a review of policy matters for the entire draft document.

The timetable was updated to incorporate the external review process into the calendar and allow time to SCICOM to review the final manuscripts.

ICES Position Paper on climate change science, draft timetable 2009–2010	
ASC Theme Session contributions (C D E F G), drafts by	31 October 2009
Thematic workshop on modedelling modelling	12 January 2010
Editorial workshop (3 days), back-to-back with PGCC, before	31 January 2010
Draft 1 completed by the end of January	31 January 2010
Draft 2 completed and highlihgts sent to Harald Loeng by	20 February 2010
Draft manuscripts to Expert Groups by	1 March 2010
External review on draft 2 from	1 March to 1 April 2010
Authors integrate the comments from referees and Expert groups	1 April to 1 May2010
Final Draft manuscipts to Executive Editor by	1 May 2010
Final Draft manuscript to SCICOM for review by	15 May 2010
Manuscript to ICES Secretariat for final quality control	31 May 2010
Launch of CRR at the ASC 2010, print by	15 September 2010

P.S.: As some of the chapters are still not at an acceptable level and not ready to sent out for review, we realised that the schedule was too tight for authors, referees, editors, designers, etc. Thus, the timetable was discussed with the Chair of Pub Com (Pierre Pepin), the Chair of SCICOM (Manuel Barange), the ICES executive editor (William Anthony), the position paper editors (Philip C. Reid, Jürgen Alheit and Luis Valdés) and the ICES Head of Sciences (Adi Kellermann) and it was decided that a new horizon for the final publication should be considered (end of 2010) and the timetable re-scheduled accordingly to give more time for external review and quality control of the entire manuscript.

The new time table was accepted by all the interveners in the discussion and adopted as the one that the SSICC has to adhere.

ICES POSITION PAPER ON CLIMATE CHANGE SCIENCE, NEW TIMETABLE 2009–2010	
ASC Theme Session contributions (C D E F G), drafts by	31 October 2009
Thematic workshop on mododelling modelling	12 January 2010
Editorial workshop (3 days), back-to-back with PGCC, before	31 January 2010
Draft 1 completed by the end of January	31 January 2010
Draft 2 completed and highlihgts sent to Harald Loeng by	20 February 2010
Draft manuscripts to Expert Groups by	1 March 2010
External review on draft 2 from	1 April to 15 June 2010
Authors integrate the comments from referees and Expert groups	15 June to 1 August 2010
Final Draft manuscipts to Executive Editor by	1 August 2010
Final Draft manuscript to SCICOM for review by the ASC	15 September 2010
Manuscript to ICES Secretariat for final quality control	1 October 2010
Launch of CRR during 2010, print by	15 December 2010

4.2 Promote and review status for ICES Symposia, workshops and theme sessions for the ASC, related to climate change and respective cooperation with PICES

Symposia

ICES is promoting (as originator or as co-convener) several symposia in climate change in the next few years.

- 2010: 'Climate Change Effects on Fish and Fisheries: Forecasting impacts, assessing ecosystem responses, and evaluating management strategies' (26–29 April, Sendai, Japan). Conveners: Anne Hollowed (United States), Manuel Barange (UK), Shinichi Ito (Japan), Suam Kim (Republic of Korea), and Harald Loeng (Norway). The symposium has gathered considerable international attention and support. More than 400 scientists from almost 50 countries have registered for the symposium and 380 abstracts were submitted. The session and workshop conveners just completed their selection of papers for oral and poster presentations and assessment of financial support applications from early career scientists and scientists from developing countries. Fund raising was very successful and up to 90 000 CND are available to fund grants for students and experts from developing countries.
- 2011: 'ICES/NAFO Symposium on Hydrobiological variability of the North Atlantic marine ecosystems during the first decade of the XXI century' (10–12 May 2011, Santander, Spain). This is the fourth of a series of ICES Symposia and in this occasion NAFO was invited to join efforts with ICES. The ICES convener and local organiser is Dr. Alicia Lavín and the SSC is co-chaired by Dr. Steve Cadrin (representing NAFO) and Dr. Einar Svendsen (representing ICES). The SSC is currently discussing the programme in order to identify the key topics for the themes sessions.
- 2011: 'Symposium on "Comparative studies of climate effects on polar and sub-polar ocean ecosystems: progress in observation and prediction' will be held in May/June 2011 in Seattle, Washington, USA. Conveners: George Hunt (USA), Ólafur Astthórsson (Iceland), and Michio Kishi (Japan). The

SSC composed by Erica Head, Ken Denman, Sei Ichi Saitoh, Ken Drinkwater, Paul Wassmann, George Hunt, Jim Overland and Mike Sigler.

- 2012: 'Second International Symposium on the Effects of climate change on the world's oceans' (Yeosu, Korea). This ICES-PICES-IOC Symposium promoted directly by the SSICC will be one of the official events related to the Ocean Expo-2012 (Yeosu, Korea) and the planned dates are 14–18 May 2012, just after the opening of the Expo (May 12). Conversations with the Government of Korea during 2009 have resulted in a generous support in terms of logistic facilities and funds. ICES, PICES and the IOC will also provide some funds for students and invited speakers. Based on our experience from the first symposium on "Effects of climate change on the world's oceans" (May 2008, Gijón, Spain), it was agreed that the 2012 Yeosu symposium will have four convenors representing the three major international sponsors and the host country. Sarah Hughes (Centre for Environment, Fisheries and Aquaculture Science, Aberdeen, UK) will serve as the ICES Convenor; Dr. Hiroaki Saito (Tohoku National Fisheries Research Institute, Fisheries Research Agency, Japan; and Chairman of the Climate, Oceanographic Variability and Ecosystems Advisory Panel) was appointed as the PICES convenor; and Dr. Luis Valdés (Head of IOC Ocean Science Section) will serve as the IOC convenor. Dr. Suam Kim was appointed as the symposium convener representing Korea. By mid-2010 the convenors will decide on the composition of the Scientific Steering Committee and the structure of the symposium. By the end of 2010 the first announcement (flyer) will be printed and distributed between December 2010 – January 2011.

Workshops (not related to the position paper)

- Workshop on Anchovy, Sardine and climate variability in the North Sea and adjacent areas [WKANSARNS], Mark Dickey-Collas (Netherlands), Pierre Petitgas (France) and Jürgen Alheit (Germany), 6–9 July 2010 Nantes (France).

Two more workshops related to climate change were proposed for 2011 by the Working Group on Small Pelagic Fishes, their Ecosystems and Climate Impacts, but these still have to be approved by SCICOM.

ICES HoS suggested that SSICC should promote more workshops in 2011 and take greater initiative with special emphasis on activities lacking in ICES.

Theme Sessions for ICES ASC 2010 and beyond

- Theme Session K: 'Global change and acquatic bioinvasions'. Conveners: Henn Ojaveer (Estonia), Stephan Gollasch (Germany) and Hugh Mac Isaac (Canada).
- Theme Session S: Joint ICES/PICES Theme Sessions on 'Responses to climate variability: comparison of northern hemisphere marine ecosystems'. Conveners: Jürgen Alheit (Germany), Harald Loeng (Norway), Anne Hollowed, PICES (USA), and Suam Kim PICES (Republic of Korea)

The deadline for submission of abstracts for the ICES ASC 2010 is 15 April, and no estimates of the number of potential contributors are currently available.

The latter ICES/PICES TS is linked with TS S8 to be held during PICES Annual Meeting (22-31 October, Portland, USA) as follow:

- Theme Session S8: Impact of climate variability on marine ecosystems: Understanding functional responses to facilitate forecasting"; convenors: Juergen Alheit (Germany), Suam Kim (Korea), Harald Loeng (Norway), James Overland (USA) and Yasunori Sakurai (Japan).

The Chair of SSICC urged the members to send proposals for workshop and theme sessions for 2011.

4.3 Review ongoing ICES's activities on Climate Change

ICES Secretariat has compiled an inventory of ToR and WGs related with climate change according with ICES resolutions 2009/2/, covering the period 2009–2010. This compilation is a 50 page document reviewing the contributions of SCICOM Steering groups: SSGEF, SSGRSP, SSGHIE, SSGSUE and SSGESST (see Annex 3).

The following are the expert groups having ToR related to climate change. In brackets are the numbers of groups addressing climate change issues and the total of groups belonging to each parental Steering group under SCICOM.

- SSGEF: SSICC, EWPPCC, WKMCCEI, SGCBNS, WGPME, WGHO, WGCEPH, WGSE, WGZE, WKMOR, WGPBI, BEWG, SGIMT, WGSPEC, WGFE. (15/23= 65.21%)
- SSGRSP: WGNARS, WKANSARNS, WGLMEBP, ICESSAS. (4/6= 66.66%)
- SSGHIE: WGMASC, WGEIM, WGHABD, WGFCCIFS, WGAGFM. (5/12= 41.66%)
- SSGSUE (0/6)
- SSGESST (0/25)

WGFE, WGAGFM, WGMASC, BEWG, WGZE, WGOH, WGFE, WGSAM, WGSE, have included ToR related to climate change 3 or more years. At least 8 of these groups are involved in the ICES position paper on climate change.

In addition to the groups established before 2009 and usually having ToR on climate change, SCICOM created in 2009 a few others than can provide expertise to ICES and could be contributors for a programme on climate change. These are:

- Working Group on Small Pelagic Fishes, their Ecosystems and Climate Impact [WGSPEC], chair Jürgen Alheit (Germany), 20 January 2010, Cádiz (Spain).
- Group on Climate related benthic processes in the North Sea [SGCBNS], chairs: S. Birchenough (UK) and H. Reiss (Germany), 1–5 March 2010, Lowestoft (UK).
- Joint PICES/ICES Working Group on Forecasting Climate Change Impacts on Fish and Shellfish [WGFCCIFS], chairs: Anne Hollowed (USA), Manuel Barange (UK), Suam Kim (Korea), and Harald Loeng (Norway), 30 April 2010, Sendai Japan

4.4 Recommendations for future ICES work in climate change under SCICOM

The SGCC (now SSICC) was created by the Council in 2007 to look at the research, services and operational issues related to Climate Change supported by ICES in their expert groups, to assess the quality and adequacy of the assessment process, and to manage the start up transit of ICES toward the establishment of a programme in Climate Change.

In 2007, ICES initiated a process to redesign its scientific structure. In 2008 an ICES Science Plan 2009–2013 was adopted in which climate change was considered a high research area. The Science Plan is now in the implementation phase and one of the most interesting novelties is the possibility of establishing cross-cutting programmes and work under interdisciplinary approaches. Improving our understanding of climate change requires such interdisciplinary collaboration and, therefore, climate change should be addressed in ICES as a cross-cutting programme.

The Chair encouraged participants to provide ideas, comments and suggestions to be included in the Work Plan of SSICC, and reminded the group of the important future tasks for the group. After the discussion a plan was prepared (Annex 4) which contains a rationale for the group, mission and objectives, responsibilities and task, membership and work procedure, benefits and products, and financial and resources requirements.

Recommendation: The SSICC encourages ICES to establish a programme in Climate Change as the main instrument of ICES work in climate change. Therefore, the SSICC recommend ICES to adopt a formal resolution from ICES governing bodies to establish such a cross-cutting programme on climate change and transform the SSICC accordingly on the basis of the roadmap prepared ad hoc.

4.5 Contribution of SSICC to the Science Plan High Priority Research topics

Based upon a review of the emerging research priorities in the member countries, and wide consultation in the ICES community, sixteen research topics have been identified as being of strategic importance to the advisory needs of ICES Member Countries and clients in the coming decade. These topics have been clustered in three thematic areas: (i) Understanding Ecosystem Functioning, (ii) Understanding Interactions of Human Activities with Ecosystems, and (iii) Development of options for sustainable use of ecosystems.

The research topics in category one (ecosystem understanding) are most directly linked to that element of the advisory process involved in furthering knowledge and understanding of how ecosystems and their components function. This knowledge is critical to defining which indicators should be assessed and what the limits of human impacts are; thus these research topics are indirectly linked to assessment and decision support.

The research topics in category two (ecosystem/human interactions) are most directly linked to the decision support and implementation elements of the advisory process. Although mitigation of the influence of human activities requires knowledge gained from category one research topics, the research undertaken in these topics is most directly associated with determining ways and means to limit harm. There is an indirect link to the assessment element as an assessment is required to gauge the level of harm that requires mitigation.

The research topics in category three (development of options) are most directly linked to assessment and decision support, with an indirect link to implementation. Again, the development of management options to address the impact of climate change and human activities will draw heavily upon research undertaken in category one.

In order to determine the capabilities of ICES expert groups in addressing the sixteen high priorities research topics, SCICOM has asked to identify their potential contribution to each of the high priority research topics.

The chair of SSGEF has provided a list of the sixteen research topics divided in 72 lines of action. The SSICC has scored each of the 72 items ranking them as blank (no proficiency), 1 (low proficiency), 2 (average), 3 (high proficiency). The SSICC has scored in 33 of 72 lines of action: 16 in Understanding Ecosystem Functioning, 7 in Understanding Interactions of Human Activities with Ecosystems, and 9 in Development of options for sustainable use of ecosystems. The detail of the scores can be found in Annex 5.

4.6 Develop plans for cooperation with relevant international organizations on issues related with climate change and identify durable working relationships

Climate change is the main driver in environmental sciences and so it is included as a programmatic activity in most international organizations coordinating marine sciences. But climate change embraces too many topics and it is beyond any organization to fully cope and address the full spectrum of impacts, consequences and test possible actions for mitigation and adaptation. Therefore, most organizations have established alliances to promote research programmes in climate change. This offers ICES great opportunities for collaboration and to establish durable working relationships with sister organizations.

In this regard, the SSICC has reviewed the scope of objectives of some relevant international organizations with core programmes in climate change. FAO, IOC, PICES, IPCC, WCRP, IGBP, JCOS, IASC, and AOSB were mentioned as potential partners for future collaboration because of their international or regional (large scale) competences or because they are directly addressed to the study of climate variability and change.

There are several reasons to enhance cooperation with Arctic organizations. The Arctic Ocean is explicitly mentioned in the 2009–2013 ICES Science Plan under the topic of sensitive ecosystems and it may receive much more attention under changing climate regimes and changed hydrology which is another topic of the Science Plan. Furthermore, some of the key areas for hydrological process, for instance the Rejkjanes Ridge and the Siberian shelf are on ICES territories. Strategically, cooperation on marine science between the AOSB and SCICOM could produce synergies and open new avenues for research.

ICES is seen from the marine Arctic science community, represented by the Arctic Ocean Science Board (AOSB) and the new AOSB/Standing Committee "Marine System", as a partner for cooperation. ICES has to be aware and play a role in Arctic research and future development of any kind of use, regulations, etc.

5 AOB and Closing

5.1 Nomination of experts for consideration as Coordination Lead Authors, Lead Authors, or Review Editors for the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)

At its 28th Session (Budapest, Hungary, 9–10 April 2008) the IPCC agreed to continue to prepare comprehensive assessment reports and to maintain the existing Working Group structure under which:

(i) Working Group I assesses the scientific aspects of the climate system and climate change. It will have dedicated chapters on sea level change, the carbon cycle, and climate phenomena such as monsoons and El Niño.
(ii) Working Group II assesses the scientific, technical, environmental, economic and social aspects of the vulnerability (sensitivity and adaptability) to climate change of, and the negative and positive consequences (impacts) for ecological systems, socio-economic sectors and human health, with an emphasis on regional sectoral and cross-sectoral issues; consistent with recent considerations it will also focus on the adaptation needs, options, opportunities, and constraints to reduce current and future risks;
(iii) Working Group III assesses the scientific, technical, environmental, economic and social aspects of the mitigation of climate change.

To enhance cross working group consistency, nine cross-cutting issues have been identified, two of them are purely addressed to ocean sciences and the third is related to oceanography:

1) Carbon Cycle including Ocean Acidification (identified as a critical topic).
2) Ice Sheets and Sea Level Rise (with implications for vulnerability and adaptation in coastal zones and islands).
3) Water and the Earth System: changes, impacts and responses (to answer the need for a water cycle theme in the AR5).

The nomination period was opened for experts who will prepare the Fifth Assessment Report as Coordinating Lead Authors, Lead Authors and Review Editors. The writing process will start in the second half of the year for Working Group I with their First Lead Authors Meeting (LA1) taking place 8–11 November 2010 in Kunming, China. Working Group II and Working Group III will begin work on their contributions in early 2011. A meeting to further develop the scope of the AR5 Synthesis Report is scheduled for 30 August – 1 September 2010 in Liege, Belgium. Next table shows the deadline for completion of AR5

COMPLETION DATES FOR THE AR5 OF IPCC
Working Group I: September 2013
Working Group II: March 2014
Working Group III: April 2014
Synthesis Report: September 2014

The nomination process for the IPCC's Fifth Assessment Report began in January. Governments and participating organizations, including all UN organizations, were asked to nominate experts who can serve as authors and Review Editors for the three Working Groups' contributions to the AR5. The Lead Authors' teams for the IPCC Fifth Assessment Report (AR5) shall reflect a range of views and expertise, and ensure appropriate representation of experts from developing and developed countries and countries with economies in transition.

The IPCC requires that the nominee(s) have appropriate expertise. All nominations should indicate the Working Group(s), chapter(s) and author role(s) for which the candidate is being nominated, a specification of the nominees' key area of expertise and be accompanied by a curriculum vitae and a list of relevant publications. The deadline to receipt of all nominations at the IPCC is 12 March 2010.

Even if this is a task demanding intense dedication, as the workload, during the period from the second half of 2010–2014, will be in the order of several months and can

be particularly heavy during certain periods, it is exciting and the SSICC asked for volunteers within the group or otherwise propose candidates from the ICES pool of experts.

Penny Holliday, John Pinnergar, Svein Sundby and Ken Drinkwater were considered and they accepted for nomination. Then, the SCICOM was consulted for approval and finally it was recommended at ICES to formally nominate P. Holliday, J. Pinnergar, S. Sundby and K. Drinkwater as lead authors.

5.2 COP 15

The negotiations in Copenhagen unfolded as follow: there were two negotiating tracks, one under the UNFCCC (United Nations Framework Convention on Climate Change), and another under KP (Kyoto Protocol) process.

The KP track remained stuck during the whole negotiations. Developing countries stressed the need for KP Parties to commit to a second commitment period of the KP.

The UNFCCC has been targeted to achieve a wide political agreement. It must be pointed out that the Copenhagen Accord was reached within a very diverse group of around 30 Heads of States and Governments, representatives from all UN regional groups, Least Developed Countries and the alliance of Small Island States, with a majority from developing countries. Although these 30 countries represent more than 80% of the global CO_2 emissions (keeping in mind that Kyoto Parties cover only 30% of emissions), the legitimacy of the Copenhagen Accord for paving the way to the adoption of a comprehensive post 2012 global regime on climate change depends on the context through which countries can be all represented to endorse its content.

Because it was informally reached in the margins of the COP to the UNFCCC, the Copenhagen Accord can be just regarded as a political declaration which only expresses an intention to act from a number of well identified countries (who are listed before the preamble part of the Accord) with respect to the way they believe the UNFCCC should be implemented in order to achieve its ultimate objective.

As a side event of COP-15, there was an 'Oceans day' that was celebrated at the premises of the EEA. Many different UN organizations, such as FAO, UNEP, IOC, IMO, etc, presented last views on effects of climate change in the oceans, ecosystems and living resources.

Information summarizing and analyzing COP-15 can be found at:

The Copenhagen Accord: What happened? Is it a good deal? Who wins and who loses? What is next? 2009. Guérin, E.L.and M. Wemaere. Institut du développement durable et des relations internationales, 10pp.

Copenhagen de-briefing: an analysis of COP15 for long-term cooperation. 2009. Paige A., M. Karaisl, P. Andrews, N. Antonowicz, R. Brandt, S. Chesterman, A. Dontenville, D. Elis, J.F. Helgeson, M. Kovič, K. McManus, N. Sarwar and O. Tonkonojenkova. Ed. by Climatico, 28 pp.

5.3 Next Meeting

Depending on the indications of the SCICOM about their interest in building a cross-cutting programme on climate change based on the existing expertise of the SSICC, the group will consider the convenience to convene an extraordinary meeting during the ASC 2010 in Nantes (France). This meeting will not be at Council expenses.

5.4 Closing

Luis Valdés thanked all participants, and expressed hope that all efforts will result in a good position paper and that SCICOM consider the establishment of a cross-cutting programme in Climate Change as the main instrument of ICES work in climate change. It is hoped that the roadmap prepared by the SSICC will be used as a basis for the future of such cross-cutting programme.

Chair thanked also the Secretariat for meeting preparations. The meeting was closed at 17:00 on 28 January 2010.

Annex 1: List of Participants (28 January 2010)

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Annex 2: Reports of 2009 ASC Theme sessions promoted by the SSICC

Theme Session D: Trends in Chlorophyll and Primary Production in a warmer North Atlantic.
Conveners: Antonio Bode (Spain), Jon Hare (USA), and Luis Valdés (IOC)

The trend in the North Atlantic in the past decade has been one of warming. Predictions throughout the 21st century forecast continued rise in temperature of 0.2°C per decade. Warmer sea temperatures have already caused shifts in phytoplankton populations, including change in abundance and distributions. These changes in primary production will certainly manifest themselves in higher trophic levels and are an important pathway for climate change to affect resource species and ecosystems. The trophic pathways of phytoplankton and microbes to zooplankton were reviewed during the session and direct links to larval fishes and overall ecosystem productivity were brought up during discussion.

Papers identified at the theme session identified several key elements of change. First, temperatures are warming; this has been documented by the WGOH and the most recent results of the WG were presented during the session (D: 01). This paper also provided guidance to the ICES community as how to use standard gridded data products of ocean temperatures. Many of the other papers included evidence of a warming North Atlantic particularly in the last 10 years (D: 04, D: 11, D: 13) while this is not evident for other regions, as in the Norwegian Sea (D: 07)

Second, changes in overall chlorophyll and primary productivity were indicated in several regions. Such changes revealed a variety of patterns among regions ranging from no significant long-term change to increases or decreases of values. For instance, on the northeast US shelf these trends were documented based on satellite data (D: 04) and indicated an increase in phytoplankton biomass and production in most shelf regions except in Georges Bank. Changes in chlorophyll concentration were also linked to changes in the bacterio-plankton and these relationships indicate complex interactions between primary producers and the microbial loop (D: 02). Temporal changes in phytoplankton indicators were also linked to changes in the zooplankton community indicating links to higher trophic levels (D: 05). Together, these papers indicate that changes in the smallest size fractions of organisms in the ocean could have important consequences for overall fishery and ecosystem production.

Third, changes in size and species composition were demonstrated that were associated with warming, stratification, and nutrient availability. Picophytoplankton increased dominance with temperature in the Bay of Biscay (D: 03) and were coherent with changes observed off the eastern Canadian coast (D: 03 and D: 02). Changes in the magnitude, timing, and species composition were found in the northeast US and these were related to temperature and the inflow of water from the north (D: 05). However, not all studies found a relationship between changing phytoplankton and changing temperatures. A study from the Bay of Biscay found an increase in temperature, but not an increase in chlorophyll levels (D: 11). Additionally, changes in bloom dynamics of several species of diatoms were presented and linked to changes in nutrient concentrations, stratification and day length but not to temperature (D: 09). Temperature was also not the dominant factor identified in changes primary production and phytoplankton biomass off the northwest coast of Spain; these changes were linked to multi-annual cycles of nutrient concentrations (D:13). The compilation of these studies indicates that temperature is but one of several factors that influence phytoplankton dynamics.

Fourth, several papers during the session supported the concept of a heterogeneous response of phytoplankton in the North Atlantic owing to spatially and temporally varying influence of different control factors (temperature, nutrients, stratification, day-length). Changes in the timing of the spring bloom are not coherent over the North Atlantic indicating regional differences (D: 14). A finer scale study in the Norwegian Sea indicated a different response of phytoplankton in two water masses and these spatially differences resulted from differences in stratification (D: 07). Similarly, differences in the phytoplankton community off the Portuguese coast were related to upwelling processes. On the northeast US changes in chlorophyll over time were identified in some areas, but in well mixed areas, little change in chlorophyll concentration was found (D: 04) and in the Barents Sea the relationship between near bottom oxygen saturation in the Barents Sea relative to primary production was reviewed (D:12). These studies suggest that regional differences in chemical and physical oceanography will affect phytoplankton and microbial dynamics independent and in concert with warming oceans.

Finally, the issue of scale was raised in several studies and directly addressed in an integration of measurements made over minutes to anomalies calculated over years (D: 02). To document changes in phytoplankton and microbial dynamics observations are required over years – over the scale of temperature changes in the system. However, microbial and phytoplankton dynamics are dependent on processes acting on much shorter scales. A challenge remaining to the community is the need for fine-scale observations over long-periods and then integrating these observations to scales that are relevant for addressing issues such as climate change and ecosystem function.

Despite this challenge, the results of the theme session are clear. Phytoplankton and microbial communities are changing throughout the North Atlantic region. Bloom times are shifting, overall chlorophyll concentrations are changing, and size and species composition are changing. Most of these changes are related to changing temperature, but result from a more complex interaction of processes. These changes will affect resource species and ecosystem productivity and understanding these effects is a major challenge for the ICES community.

Based on continued interest in phytoplankton and microbial ecology within the ICES community and the fundamental importance of this group of organisms to the ICES Science Plan, a proposal for a new ICES WG was developed by theme session participants and attendees.

Theme Session E: Climate Impacts on Marine Fish: Discovering Centennial Patterns and Disentangling Current Processes.
Conveners: Myron A. Peck (Germany), Brian MacKenzie (Denmark), Skip McKinnell (PICES), and Corinna Schrum (Norway)

The goal of the session was to provide a venue for the presentation and discussion of both long-term (historical) and current (process based) research on the impacts of climate variability and change on marine fish species. A second goal was to foster the links that have been established between PICES and ICES in terms of research targeting climate impacts on marine fisheries. The session attracted the largest number of submissions at this year's ICES ASC. In total 28 oral presentations and five posters were delivered. Presentations covered a wide range of topics that, for convenience in this session report, could be separated into different categories (Figure 1). Presentations focused on: 1) examining correlations between the vital rates of single species

and environmental variability, 2) evaluating the impacts of climate variability and change on multiple populations / community analyses, 3) constructing and analyzing long-term / historical data sets, and 4) process studies utilizing biophysical modelling and other methods. Naturally, most presentations could be included within multiple categories (categories were not mutually exclusive). A final discussion period summary is also included at the end of this report.

The most common theme of presentations centred on correlative studies of various time series data emphasizing a single population and/or stock and its variation due to environmental factors. One presentation (E:27) attempted to test the hypothesis that cohort survival and year class success of striped bass (*Morone saxatilis*) were associated with periods of strong river discharge due to changes in the dynamics of an estuarine turbidity maximum zone (TMZ) in the upper Chesapeake Bay estuary. This and other correlative studies speculated on the causal mechanisms and processes underlying trends in time series data including changes in vital rates (rates of survival, growth, reproduction) and/or distribution. Time series data were often statistically evaluated with respect to various environmental factors and/or climate indices such as the Gulf Stream index (GSI), the North Atlantic Oscillation (NAO), the Atlantic Multidecadal Oscillation (AMO) or the Siberian High. These included studies on redfish (*Sebastes mentella*) in the Irminger Sea (E:15), haddock (*Melanogrammus aeglefinnus*) on the Scotian Shelf (E:31), Pacific cod (*Gadus macrocephalus*) in the Yellow Sea (E:28), two studies on European sardine (*Sardina pilchardus*) on the Iberian Atlantic coast (E:20 and E:30) and saithe (*Pollachius virens*) in the Faroe Islands (E:23). Some of these studies included relatively long time series data, including work on spawning stock biomass of Northeast Artic cod (*Gadus morhua*) (1946–2002) (E:05, see Fig. 2), the condition of saithe (1962–2007) and Pacific cod (1969–2006), size at age of haddock (1970–2008) and egg production rates by Baltic cod (1957–1996) presented in E:06. One poster presentation examined the response of yellowtail (*Seriola quinqueradiata*) in Japanese waters to sea water temperature over the last century (E:34). Most studies evaluated stocks using data collected after 1970, concentrating on time series that included years associated with a regime shift (e.g., late 1980s in the North Sea).

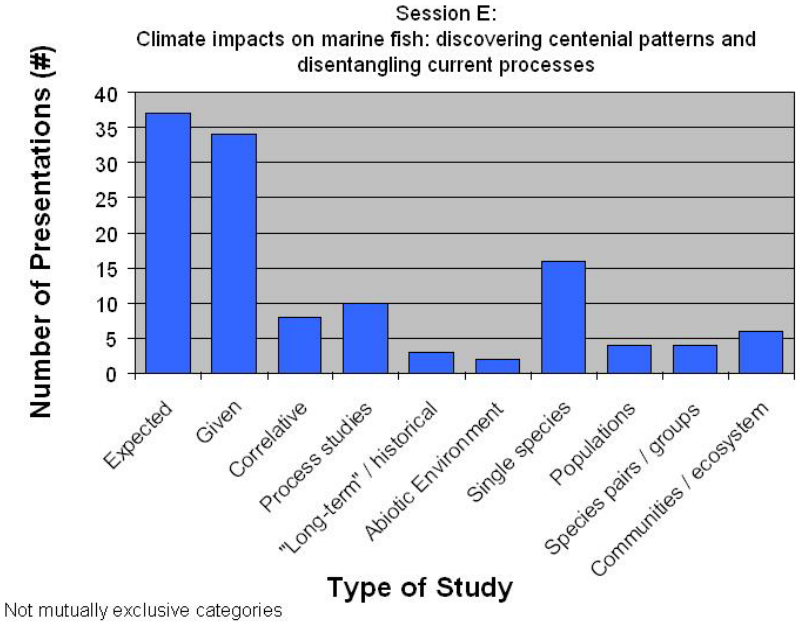


Figure 1. Overview of presentations (oral and poster) within session E including various study categories. Note, most studies can appear in more than one category.

1) Single species/stocks.

Trends in some time series of abiotic factors were related to the ecophysiology of specific life stages (e.g., eggs and larvae of Pacific and Baltic cod; E:28 and E:04, respectively). A particularly interesting example of this was a presentation calculating the impacts of increased hypoxia (low dissolved oxygen concentrations) on various life stages of Baltic cod including: egg survival (6% decrease per decade), larval vertical migration (~5% / decade), juvenile settlement (area decreases of 900 km^2 per decade), feeding of adults based upon gastric evacuation rate (decrease about 5% per decade) and adult age dependent egg survival probability (larger / older females produce larger more buoyant eggs). The latter calculation indicated an increase in the female age from 4 to 8 years based on the probability for 50% egg survival. Utilizing ecophysiology to understand climate impacts was a theme discussed within two posters (E:37 and E:38).

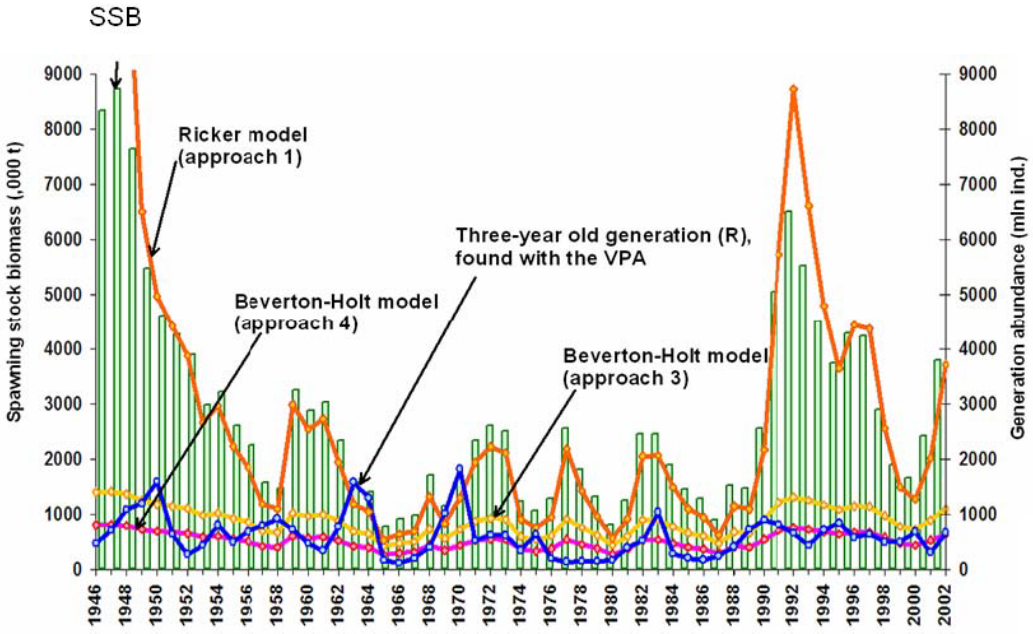


Figure 2. Example of single species time series data presented in Session E: Spawning stock biomass of Northeast Arctic cod. Environmental factors were included (e.g., four-year mean weighted temperature anamolies at the Kola section) and the stock separated into three productivity regimes to help generate robust recruitment predictions (for details, see Kotenev *et al.* E: 05).

2) Multiple populations/community analyses

A few studies evaluated climate driven changes in demographic features of different populations or vital rates of conspecifics inhabiting different ecosystems. This included work on various spawning stocks of Atlantic herring (Clupea harengus) (E:17) as well as Atlantic cod (*Gadus morhua*) larvae on Georges Bank, around Iceland, in Lofoten and the North Sea (E:03). A third example evaluated environmental impacts impacting juvenile salmon emerging from 60 different Norwegian rivers (E:27) identifying common trends and river-specific patterns due to differences in land use / anthropogenic activities. In the Baltic Sea, spatial differences in the rate of change in water temperature (depth-specific) were assessed with regard to potential impacts on key fish species based upon ecophysiological thresholds (tolerances to abiotic factors) of early life stages of sprat (*Sprattus sprattus*) and Baltic cod. Other presentations ex-

amined the impacts of climate variability (5 to 20 years) on changes in species pairs such as potentially competing flatfish species in the North Sea (E:02) and the community composition of fishes within various systems. The community level analyses included work in the Barents Sea (E:21) and North Sea (E:11) with an emphasis on demersal fishes and their habitat characteristics (including potential prey species).

One presentation reconstructed the fisheries landings in the North Sea since the 1890s (see Figure 3) and asked the question: Can one describe time series in changes in fish stocks using only catch data – or does one also need to include climate as an explanatory variable? This modelling effort with ECOSIM had 46 functional groups, including seabirds, seals, sharks, cephalopods with time series built from a variety of sources. Five fishing gears were used in the model (seal hunting, trawlers, drifters, etc. The presentation provided a clear example of process oriented research attempting to disentangle the effects of exploitation (fishing) and climate.

A world-wide view of climate impacts on fisheries was provided by Sherman *et al.* (E:01) who summarized data series on fisheries catches in 64 large marine ecosystems that, together, account for > 80% of fisheries production. Based upon analyses of temperature time series from 1982 to 2006, these systems were classified as having either slow (n= 23), moderate (20), fast (12) or "super fast" (6) warming (Figure 4). The share of world-wide fish production within large marine ecosystems has declined in the last 25 years.

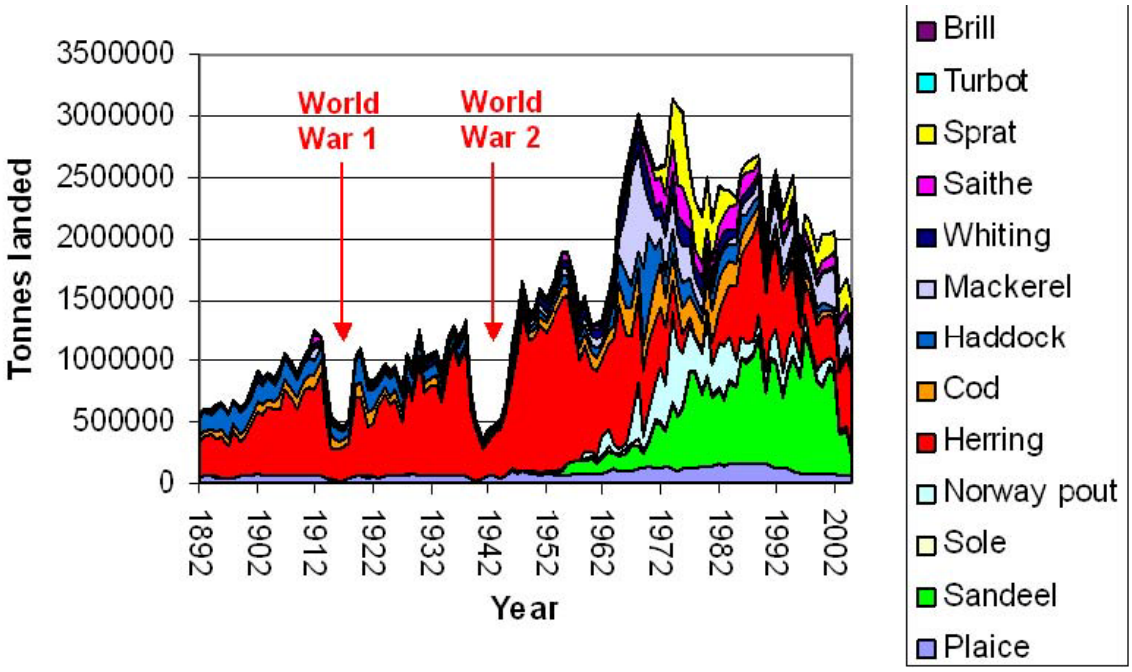


Figure 3. Time series of landings for various fish species in the North Sea (Pinnegar *et al.* E:24). This analysis was part of a modelling exercise (ECOSIM) attempting to disentangle the impacts of fishing and climate on the North Sea fish assemblage.

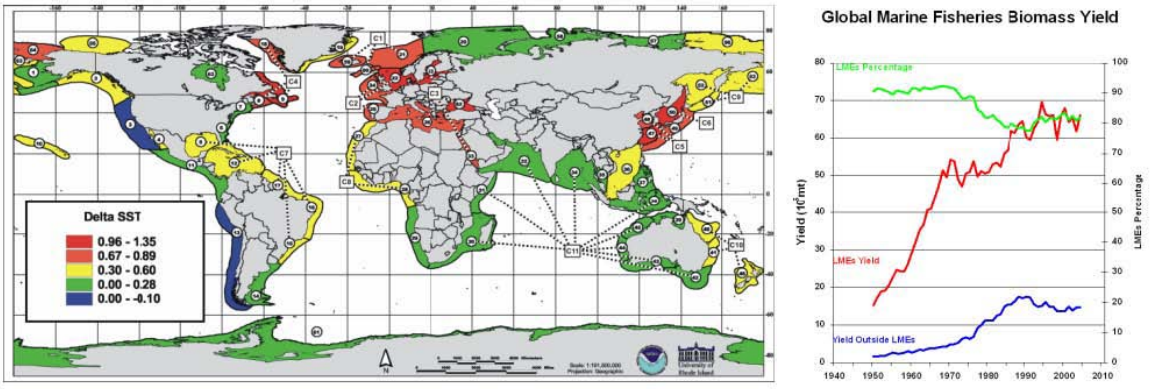


Figure 4. Map of 64 large marine ecosystems (LMEs) with colour code indicating relatively slow (blue) to rapid (red) trends in warming from 1982 to 2006. The right panel indicates fisheries yields within and outside of LMEs versus time since the 1950's. The share of world-wide catches coming from LMEs is indicated (green line). From Sherman *et al.* (E:14).

3) Long-term Historical Studies

The longest time series (1520s to 1960s) was provided by Caballero-Alfonso *et al.* (E:10) describing changes in blue-fin tuna (*Thunnus thynnus*) caught using almadrabas traps, a traditional fishing method that has been employed since ~900 BC (Figure 5). Catches in various regions were analyzed with respect to a number of environmental factors including precipitation, solar irradiance, SST, air temperature, sunspot number, volcanic dust and the concentration of green house gasses. Almost all climatic patterns were significantly correlated with catches, but green house gasses were the most important single factor along with temperature.

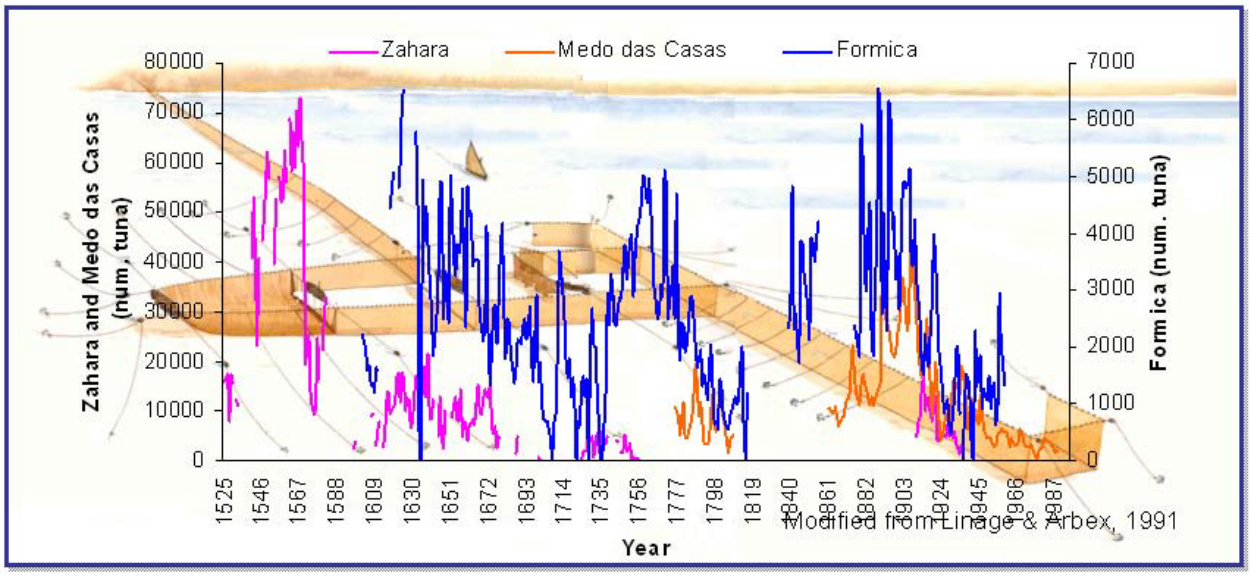


Figure 5. Catches of blue-fin tuna from almadrabas traps from these sites in the western Mediterranean (from E:10).

A second presentation (E:12) reconstructed rates of fishing mortality and environmental stressors (e.g., jellyfish outbreaks) impacting Atlantic herring within Danish (Limfjord) waters during the 1800s. The message from that presentation was that overfishing makes ecosystems more vulnerable to trophic reorganization which can result in fish populations that are more vulnerable to future collapses. A third presen-

tation (E:01), presenting North Sea time series data from the 1890s onwards was discussed in a previous section.

4) Biophysical processes

Key processes impacting early life stages of marine fish were examined within a number of presentations. Both match-mismatch (prey field dynamics) and transport (member vagrant) dynamics were examined. For example, transport mechanisms were also the main theme in a presentation summarizing trends in transport (via upwelling filaments) and changes in the larval clupeids assemblage in the Canary Islands (E:16). A second presentation employed hydrodynamic modelling to explore seasonal and inter annual transport dynamics of European anchovy (*Engraulis encrasicolus*) in the Bay of Biscay (E:08). The latter study explored climate-driven changes in transport patterns by statistically interpreting drift routes via dispersion kernel analyses.

The impacts of climate driven changes in prey fields (e.g. match mismatch dynamics) were assessed using coupled 3D Biophysical modelling of early life stages of Atlantic cod, European anchovy and Atlantic herring in European waters. Climate driven changes in key abiotic/physical factors such as wind fields, solar irradiance and associated hydrographic impacts (current fields and water temperatures) were examined using scenario modelling. In one study, a mechanistic (physiologically based), individual based model that included foraging and growth subroutines was employed to calculate historical (1970 to 2005) changes in prey requirements of larval herring in the North Sea and the potential for climate driven "bottom-up" regulation of survival during the larval over-wintering period (E:09). In a second example, climate driven changes in prey fields were included in simulations by coupling an NPZD (nutrient phytoplankton, zooplankton and detritus) model and generating prey fields for an individual based model constructed for larval Atlantic cod (E:18). The NPZDIBM was used to generate maps of potential larval survival (Figure 6). A main message from that presentation was that a number of environmental factors can interact to influence model estimates of survival and that caution must be taken when only analysing temperature impacts.

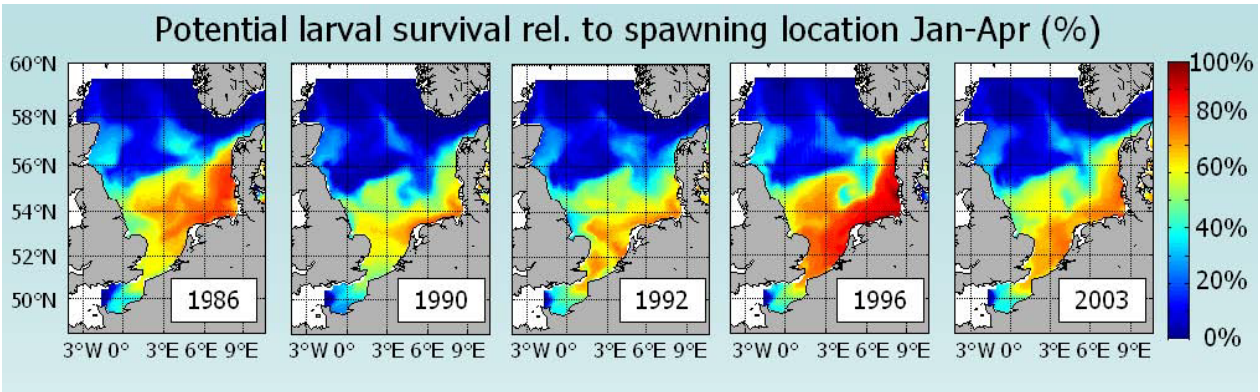


Figure 6. IBM-based estimates of potential survival of Atlantic cod larvae in different years in the North Sea. Among these years, 1996 was the coldest (negative NAO) year. (from Daewel *et al.* E:18).

The impacts of spatio-temporal variability in environmental factors on early life stages were also examined using a dynamic energy budget (DEB) approach which identified areas based upon unsuitable combinations of temperature and food to support energy allocation into reproduction by adult anchovy in the Bay of Biscay

(E:22). Finally, North Sea and Bay of Biscay hydrodynamic model outputs were analysed with respect to their spatio-temporal variance attributes using empirical orthogonal function (EOF) analysis and correspondence of those hydrodynamic factors to one another and in time using multi factorial analysis (MFA). The variance of key factors was then discussed in relation to the timing of key life history events of fish species inhabiting both shelf sea areas.

Finally, a presentation by Curchitser (E:26) described ongoing efforts to construct end to end models to explore climate impacts in the North Pacific Ocean. That modelling effort includes: 1) multi scale ocean and atmospheric physics, 2) community based lower trophic level biology and 3) spatially explicit, full life cycle, individual based higher trophic level biology including a fishing fleet. A multi species fish model can simulate 5–6 species using an individual based approach; species can compete for food resources and eat each other. One species can represent a fishing fleet. The model will explicitly model growth, mortality, reproduction and movement. The presentation also highlighted issues concerning downscaling from global climate models to regional hydrodynamic impacts. The presentation highlighted future advances that will be necessary (e.g., incorporation of deterministic and probabilistic elements) and the need for observations to be made at the same "big picture" scale as is being used in complex model development.

5) Final Discussion

The session ended with a half hour discussion period. To stimulate discussion, the conveners posed four questions to the audience:

1) Have we learned all we can from time series and correlation analyses?
   a) How much process understanding is "enough"?
   b) When do you know you have "enough" knowledge for a question of interest
   c) Has uncertainty been adequately addressed?
2) Are climate impact studies on single-species level sufficient for Ecosystem Based Management?
3) What messages do we wish ICES to put out to the "scientific community" in its "White Paper" on climate change impacts on marine ecosystems?

Given that it was the last session on the last day, the audience became vigorously engaged in the discussion, although not always on the questions posed. Main comments from the discussion included:

Time series and correlative analyses are an essential first step in the development of process understanding. The importance of long-term data sets (and the need to continue their collection) was stressed. Continued data mining and compilation of long-term data sets are essential activities and more value may be obtained from them by subjecting multiple time series data sets to meta-analysis using, for example, the traffic light approach. Time series are essential for assessing model results.

There is a need to understand the effects of ocean acidification on fish, in addition to the calcareous organisms. A convener noted that the lack of presentations on ocean acidification in the session may be because ocean acidification is a CO2 pollution problem, not a climate change problem.

Communication of ICES results within peer reviewed, high impact literature may be a more rapid route to engaging the public and should be utilized along with the pub-

lication of an ICES cooperative research report focusing on climate impacts. The vast majority of studies discuss negative impacts of climate change. However, some benefits can also be expected (in particular areas and/or for specific species) and these should not be overlooked.

An upcoming symposium in Sendai (April 2010) sponsored by ICES, PICES and FAO was advertised as a venue for research on climate impacts on fish and fisheries. Associated workshops to that conference will address ocean acidification, policy, and other topics.

The need for better laboratory data on physiological tolerances of various life stages of fish species was indicated including basic data on interaction effects (e.g., dissolved oxygen and temperature vs. growth and survival of larval fish).

Community level analyses often reveal important responses to environmental variability / climate trends that single species analyses do not.

Theme Session F: How does fishing alter marine populations' and ecosystems' sensitivity to climate?
Conveners: Benjamin Planque and Miguel Bernal

Spatio-temporal fluctuations in marine populations are modulated by a number of drivers, which can be generally classified into climate drivers, human effects and internal dynamics. The relative influence of the different classes of drivers varies across populations, due to factors such as geographical distribution, population structure and fishery characteristics. However, there is increasing evidence that the different effects may not be independent/additive, but rather interrelated/multiplicative, and therefore cannot be fully disentangled.

The objective of Theme Session F was to analyse the interactions between the different groups of drivers, in particular the interactions between human effects, climate and internal drivers. A range of approaches, from empirical analysis to modelling and simulation was expected, and one of the main scopes was to evaluate if new evidence (empirical or theoretically based) could be provided to support or falsify the hypothesis that exploited marine systems are more sensitive to climate than less exploited ones.

An overview of the climate fishing internal controls and the dilemma between additive and multiplicative approaches was presented in an introductory talk by the session conveners (Figure 1; two panels with the three classes of drivers in an additive or interactive fashion). The rest of the presentations (a total of eight) in general addressed interactions between two or three of the groups presented in Figure 1. Empirical evidence of interactions between human effect, internal dynamics and climate drivers was presented at least in two of the presentations (Hidalgo *et al.*, 2009; Nye and Link, 2009) using either an extended version of stock recruitment model that includes environmental drivers for a number of North Atlantic fish species (Nye and Link, 2009; Figure 2) or spectral analysis techniques on environmental and fisheries time series data in Mediterranean hake (Hidalgo *et al.*, 2009; Figure 3).

Also, theoretical support and a set of hypotheses that relate fluctuations due to interactions between internal dynamics and human effects alone, without climate modulation, were presented (Daan *et al.*, 2009). Under the scenario presented in that work, changes in internal dynamics induced by human exploitation play an important role in stock fluctuation, and can lead to misleading signals in stock assessment and in

analysis trying to link stock fluctuation with climate variability, without having into account interactions with human and internal dynamics.

Some empirical evidence on the effect of human and climate drivers at community level were also presented, for case studies on the Bay of Biscay (Guénette *et al.*, 2009), and the Barent sea (Aschan *et al.*, 2009). Reduction of upper trophic levels biomass in relation to lower trophic levels biomass (Guénette *et al.*, 2009), as well as a reduction in the demersal *vs* pelagic species ratio (Aschan *et al.*, 2009) was observed in those communities as a result of both human and climate drivers, although synergies between the drivers were not directly investigated. Alterations in the composition of the benthic fish community in the North Sea under current human pressure scenarios and a changing climate scenario were also predicted, driven by food competition and changes in food availability, based in a mixture of some empirical evidence and a set of theoretical assumptions (Van der Zoon *et al.*, 2009).

Two more presentations addressing the combined environmental, fisheries and biological data available to pursue climate, human and internal drivers effects studies (Pinto *et al.*, 2009) and the effects in human societies of climate human driven population fluctuations completed the session (Charles, 2009).

Discussion

A number of issues were raised in the brief discussions between presentations and at the end of the session. One of the first things raised was that the topic of the Theme Session generated a relatively high interest, judged by the high attendance, but the amount of presentations received was relatively low. Together with the fact that only very recent literature is available on the topic with a small body of empirical evidence and a lack of general hypothesis in this field, suggested that the proposed theme is at an early stage of development, especially in the ICES community. Controversy on the degree of interactions among drivers and their relative influence emerge from some of the presentations and from recent literature. Theoretical and empirical support for interactions between human and climate drivers on population dynamics are available in the literature and were presented in this session (e.g. Hidalgo *et al.*, 2009), but opposite conclusions also exist in the mainstream literature (e.g. Anderson *et al.*, 2009). Theoretical support for strong interaction between internal dynamics (density dependence and growth rates) and human effects, without the need for environmental control, were also presented in the session for some specific cases in which the population is on the verge of collapse (Daan *et al.*, 2009). These apparent contradictions may indicate that conclusions on the relative influence of each group of drivers, as well as the relative influence of the interaction between them may be high case specific.

Different difficulties on the progression of research in this area were foreseen during the discussion. First, the requirements for long data series of both biological and environmental parameters are quite high to obtain the necessary contrast in the analysis. Existing time series, data recovery and accessible databases are therefore crucial for the development of scientific approaches to analyse climate, human and internal dynamics effects on marine systems. Climate and ocean simulation were also cited as a general requirement to advance in the field. However, those tools were not much used in the presentations included in the session, and were expected to be covered by some of the other Climate oriented Theme Sessions of this Annual Science Conference. One specific problem that was discussed in this session is the scale problem; how to mix fishery data with environmental and climate data and ultimately with

impacts on the society. No clear solution was proposed, although downscaling, and up-scaling within model simulations was expected to provide some solutions.

The joint study of climate-fishing-internal controls on marine populations, communities and ecosystems was therefore described in this session as a complex area, which requires the integration of various sources of data, at different scales, and a broad spectrum of science branches. We expect that some time will be required before adequate models are available that provide reliable tools for investigating the consequences of possible management options for particular marine systems. Parallel robust management strategies that recognize the high uncertainty in predictability and the low controllability of marine systems under variable climate and human exploitation scenarios must therefore be developed while this area of science develops.

(For a list of presentations, please check the conference site: http://www.ices.dk/iceswork/asc/2009/index.asp)

Additional reference:

C. N. K. Anderson, Hsieh, S. A. Sandin, R. Hewitt, A. Hollowed, J. Beddington, R. M. May, and G. Sugihara. 2008. Why fishing magnifies fluctuations in abundance. *Nature*, 452:835–839.

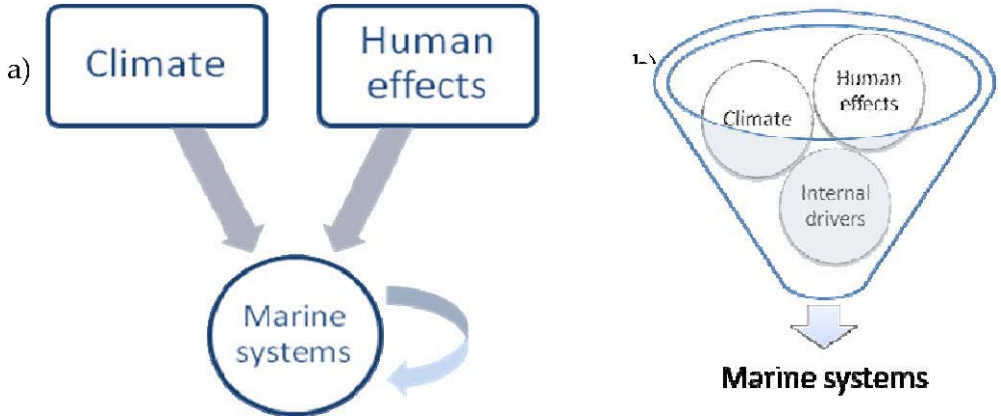


Figure 1. Schematic classification of drivers affecting marine systems fluctuations (climate, human effect and internal drivers). Left panel (a) summarises the analysis made in most works (additive/independent effects of the different classes of drivers). Right panel (b) indicates a framework in which the different classes of drivers interact with each others, producing non-linear multiplicative effects.

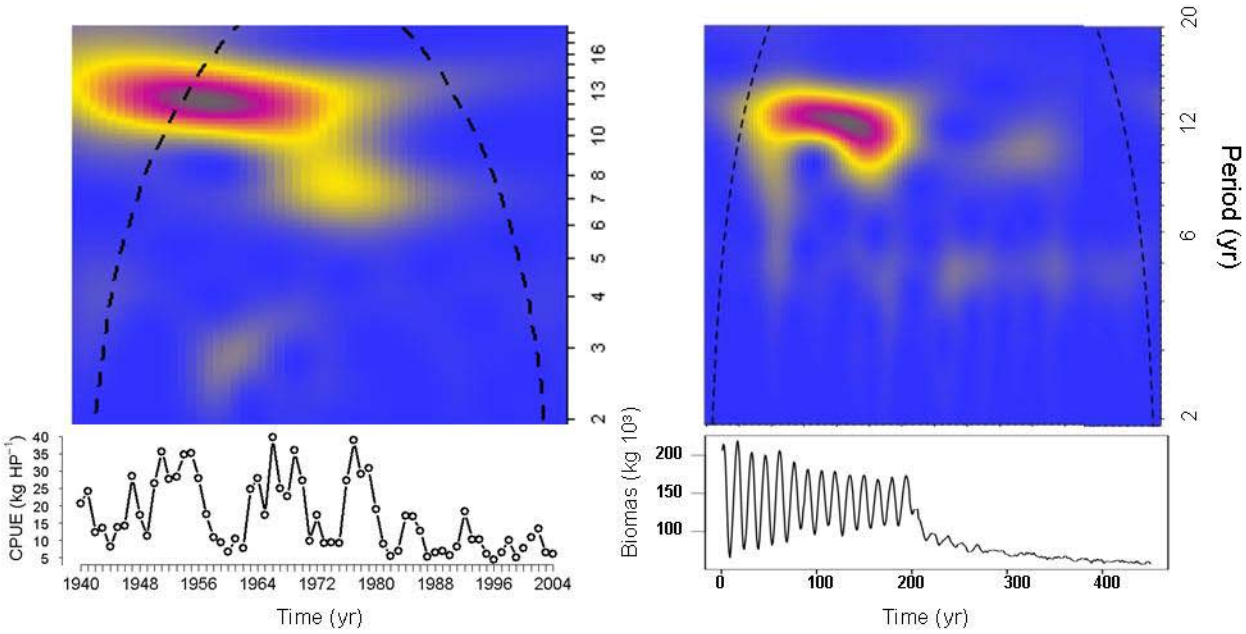


Figure 3. Change in the frequency of hake observed CPUE (left panel) and simulated biomass fluctuations (right panel). Bottom panels show the time series while upper panels show the spectral analyses. Fluctuations periodicity of the observed CPUE was different before and after a regional change in climatic conditions in the Mediterranean Sea in the early eighties (left panel). The time series spectrum of the hake population simulated biomass (upper right panel) was recreated by an age-structured stochastic simulation model which includes environmental forcing and age-selectivity removal (natural and fishery induced). A combined synergic effect of climate and human exploitation on fluctuation frequency was concluded from this analysis (Hidalgo *et al.*, 2009)

Title Theme Session G: Comparative study of climate impact on coastal and continental shelf ecosystems in the ICES area: assessment and management. Conveners: Jürgen Alheit (Germany); Stephen Brown (USA); and Ken Drinkwater (Norway)

Session Synopsis in Call for Papers: Whereas the impact of climate variability and change has been intensely studied in single marine systems or on single species/species groups across several systems, few comparisons of climatic influences on coastal and continental ecosystems in the Atlantic realm have been carried out so far. There is empirical evidence that gradual increases in temperature and associated physical factors can be amplified in coastal communities, such that biotic variables may be early indicators of climate change. Some implications for managing coastal resources are that existing fisheries may become unsustainable while new fisheries arise for species with shifting distributions. Biological reference points may need to be revised in response to changes in productivity and carrying capacity; a precautionary approach may be required to cope with rapid and unanticipated changes; and new management approaches may be needed to address the temporal scale at which climate changes occur. As marine ecosystems are not amenable to experimental investigations with respect to climate impact, the comparative method is the best way to enhance our knowledge on the reaction of ecosystems and the populations embedded in them. Contributions were encouraged to address climate induced changes

in a comparative manner with respect to ecosystem structure and function, species distributions, and phenology. Examples of integrated ecosystem assessments were sought.

Fourteen papers and four posters were presented in this session with an audience of between 45 and over 100 through the session. The comparative studies generally fell into two main areas, one comparing responses on a particular species due to different environmental conditions and the other comparing different regions The geographic scale of the comparative studies ranged from small local areas, as in single estuaries or embayment; to regional, such as within the Baltic Sea or the Gulf of Maine; to comparison across four ocean regions of the Northern Hemisphere; to the entire Northern Hemisphere considered as one tele-connected system. Geographically, most of the papers looked at regions within the ICES study area, with half of the papers providing analyses of the Baltic and adjacent seas. An interesting contrast was provided by a case study of the lobster fishery along the east coast of Tasmania.

It was widely recognized in the session that physical changes in the environment caused by changes in the climate, often in combination with the impacts of human activities, can drive ecological changes. All of the papers in this session were based on this fundamental concept.

The most compelling work involved sophisticated analyses that integrated information from numerous physical and biological data sets. Blenckner *et al.* combined 218 data sets across six regions of the Baltic Sea, and, using a combination of principal components analysis and general additive models, detected fairly synchronous regime shifts in these regions, driven by climate, fishing, and eutrophication. Niiranen *et al.* combined multivariate analyses with Ecopath and Ecosim modelling to investigate mechanisms for the regime shift in the Baltic, including the decline of the cod stock and increase in the sprat stock. Frusher *et al.* examined how projected increases in water temperatures in Tasmanian waters may impact lobster growth and recruitment, kelp habitats, and species invasions by 2070. Suursaar *et al.* modelled the Väike Strait in the Balticprior to the building of a causeway that blocked the entire flow through the Strait and compared it to post-causeway situation. Alheit *et al.* took a hemispheric perspective, looking at how changes in patterns of atmospheric pressure can lead to changes in winds and currents, causing synchronous regime shifts in widely separated regions of the world's oceans.

The session concluded with considerable animated discussion. The audience and speakers generally agreed that the comparative approach provided useful insights. Support was expressed for both modelling, which allows integrated analyses and development of hypotheses for large systems, as well as experimentation for testing hypotheses. The importance of regime shifts in understanding the influence of climate on coastal and marine ecosystems was recognized, and was suggested as a future theme session for an ICES Annual Science Conference.

Although several presentations included sophisticated analyses of complex datasets that yielded promising results, concern was expressed that this complexity may make it difficult to communicate this information and hence influence public policy. One member of the audience wondered how the results could be explained to a neighbour. This led to a brief discussion about the possibility of developing indicators of climate change and regime shifts, which might have predictive power that could also be communicated to a non technical manager and to the general public.

It was recognized that modelling can provide the means to assess different scenarios, addressing questions of "what happens if?" This is information that managers often

need. Insights and understanding of mechanisms can be gained, and models can be developed and tested, by studies of similar species in different systems, comparisons of subsystems within systems and comparisons of similar systems in different regions, and by comparing systems across large regions.

Annex 3: SCICOM EGs Climate Change Compilation 2009–2010

SSGEF Terms of Reference 2009

2009/2/SSGEF01 The **Steering Group on Climate Change** (SGCC), chaired by Luis Valdés, France, and Jürgen Alheit*, Germany, will be renamed the **Science Strategic Initiative on Climate Change** (SSICC), and will meet back to back with the **Editorial Workshop for the Position Paper on Climate Change** (EWPPCC) at ICES Headquarters, Copenhagen, Denmark, 28 January 2010 to:

a) Prepare the first draft of the ICES Position Paper on climate change science to be sent out to relevant EGs for review;

b) Promote and review status for ICES Symposia, theme session for the ASC and workshops related with climate change;

c) Review and summarise ongoing ICES' activities on climate change;

d) Make recommendations for future ICES work on climate change and related aspects under SCICOM;

e) Prepare the procedure for providing the most recent information available on climate change for the ICES website with a view to establish direct access and improved use by ICES science and advisory programmes;

f) Develop plans for cooperation with relevant international organizations on issues related with climate change and identify durable working relationships.

SSICC will report by 15 March 2010 for the attention of SCICOM.

Supporting information

Priority	This group was established by the Council in 2007 and it is a basic element for the visibility of ICES activities in climate change, it combines the expertise of existing expert groups with ad hoc workshops in order to structure our current capacity in a cross-cutting project/programme. The group members bring a wide range of experienced expertise and enthusiasm to bear on this topic that is a central question in ICES concerns. Thus the work of this group must be considered of very high priority and central to new ICES Science structure.
Scientific justification	(a) The ICES position paper on climate change is now planned for the next ASC (2010). The list of contents has been prepared by the SSICC and now the drafting of chapters has started. The group has to review and correct the contributions in time. It is also necessary to be aware of recent discoveries and documents published by others in order to access the best sources of information and avoid undesirable duplications in the content with other bodies. (b) SSICC is promoting several symposia on climate change during 2010–2012. The details in the preparation of these symposia and the promotion of other symposia and workshop is a main task for the group. (c) The review of Tors related with climate change by the different comittees and expert groups done by the Secretraiat as a Tor of this group have demonstrated the involvement of ICES in issues related with climate change under different topics. The current work of the different expert groups will be reviewed every year in order to avoid duplication, explore synergies and to ensure that key scientific issues are addressed by the Expert Groups and that there are appropriate interactions between scientific disciplines. (d) The SSICC has a 3 years mandate from the Council and it would be

	necessary to identify possible avenues for the group under the new scientific structure. (e) ICES visibility in climate change aspects needs to be increased at the different levels of ICES structure: advisory, scientific and communication (Secretariat). SSICC would like to help in making this role of ICES more prominent. (f) There are many international councils and agencies working on the diffferent aspects and implications of climate change. ICES should play a prominent role in topics related with climate change and should aspire to be seen as a robust and permanent consultative body in these activities.
Resource requirements	The group will need the usual resources and facilities as in other meetings
Participants	The group has an enthusiastic core membership made by chairs of other expert groups from several Committees. The Group is normally attended by some 15-20 members and guests.
Secretariat facilities	Assistance of the Head of Science Programme, Head of Data Center, and Departmental Secretary.
Financial	SSICC is funded by the ICES SIF, and this meeting is on ICES expenses.
Linkages to advisory committees	The Group reports to SCICOM, but their advances are also relevant for ACOM.
Linkages to other committees or groups	SSICC results are relevant for many working and study groups interested in climate change.
Linkages to other organizations	Links with other organizations are intended and some contact is maintained. For example some theme sessions and symposia proposed by this group are in collaboration with our PICES and IOC colleagues.

2009/2/SSGEF02 The **Editorial Workshop for the Position Paper on Climate Change** (EWPPCC), chaired by Philip C. Reid*, UK, will meet at ICES Headquarters, Copenhagen, Denmark, 25–27 January 2010 to:

a) Ensure that the content of each contribution is well targeted to the proposal of this publication;

b) Control the quality of the scientific content of the entire manuscript;

c) Unify the style, identify gaps and re-write the sections when necessary;

d) Format the manuscript according to the 'instructions to the authors' of the ICES Cooperative Research Report series in collaboration with the ICES official editor;

e) Select the most appropriate figures to illustrate the main points and data presented in the different chapters, and when possible prepare illustrations using ICES data in collaboration with the ICES Data Bank;

f) Consult with the members of the SSICC (meeting back to back with this workshop) on any points of conflict which need clarification or need to be completed or expanded;

g) Edit and submit the entire manuscript to the chair of the SSICC by 25 February, who will then send it out for review by relevant EG and external scientists.

EWPPCC will report by 25 February 2010 for the attention of SSICC and SCICOM.

Supporting information

Priority	This workshop is essential to control the quality of the scientific content of this publication that aspires to be the official ICES view on climate change. This workshop is also necessary to unify the style and to identify the points that need a clarification or should be completed or expanded. Thus the work of this group must be considered of very high priority and central to the success of the ICES position paper on climate change.
Scientific justification	The ICES position paper on climate change is planned to be finished by the 2010 ASC. The list of contents have been prepared by the SSICC and now the drafting of chapters has started. The Editorial Group has to review and correct the contributions in time. It is also necessary to be aware of recent discoveries and documents published by others in order to access the best sources of information and avoid undesirable duplications in the contents with other bodies. The ICES data must be used as a main source of data for the ICES position paper. This will add value to the ICES data collections and their instruments to exploit the information. This CRR will be a valuable contribution to ICES in the topic of climate change, and must be edited and reviewed prior to publication. The executive summary will be written by the SSICCand it will represent the official view of ICES on climate change.
Resource requirements	The group will meet at ICES HQ and it will need the usual resources and facilities as for other meetings.
Participants	The participants of this Editorial Workshop will be the key contributors of the individual chapters, i.e.: the editor, some members of the expert groups, and the conveners of the Theme Sessions and Workshops. In total they will be around 20 experts. In the case that a conflict arises during the editorial processes, the view of SSICC will prevail.
Secretariat facilities	Assistance of the Head of Science Programme, Head of Data, and Departmental Secretary.
Financial	The Workshop will be funded by the ICES SIF allocated to the SSICC. So this meeting is at ICES expense.
Linkages to other committees or groups	The product of this Editorial Workshop is relevant for the many working groups and others involved in the redaction of the different chapters.
Linkages to other organizations	Experts from other organisations such as the IOC or the ESF and international scientific programmes related with climate change (e.g. GLOBEC, IOCCP) will be invited to act as external referees.

2009/2/SSGEF04 The **Workshop on How Models help us to understand Climate Change Evolution and Impacts in the Regional Oceans** (WKMCCEI), chaired by Stephanie Ponsar*, Belgium, will meet in Brussels, Belgium, 12–14 January 2010 to:

a) Review of the state of the art in modelling the feedbacks of the ocean on climate change.

b) Comparison and validation of models for predicting effects of climate change at basin and regional scales. Identify how ICES data can contribute to validate the models.

c) How models can predict the effects of climate change at a lower spatial scale (downscaling).

d) How the response of the ecosystems to climate change can be anticipated using models.

e) Modelling the production and trophic interactions up to the highest level and how the changes in the flow of material through the food web affect the ecosystem structure.

f) Summarise the outcome of the workshop into a draft chapter for the attention of the SSICC.

WKMCCEI will report by 15 February 2010 for the attention of SSICC and SCICOM.

Supporting information

Priority	This workshop is essential to respond to many questions that are crucial to anticipate changes in the ecosystems as a consequence of climate change and when possible adopt the policies for adaptation or mitigation. ICES does not have the expertise to respond to these questions and consequently it is necessary to invite experts from academia to lead this discipline. The group MUMM (Belgian Management Unit of the North Sea Mathematical Models) has offered its experience and is willing to collaborate with the ICES SSICC in writing the chapter on "How models help understand climate change evolution in the regional oceans". Thus the work of this group must be considered of having a high priority and being central to the success of the ICES position paper on climate change.
Scientific justification	Models are powerful tools to help us to understand the processes and the functioning of marine ecosystems, but the results of the models are very often projected beyond their significance or are used in an inappropiate manner. Making projections about the effects of climate change in the marine ecosystems is a sensible task and we must be cautious on the assumptions we are making and the manner that the results are interpreted. There is a scientific need to review the state of the art in modelling the feedbacks of the ocean on climate change and also to ensure credible comparison and validation of models for predicting effects of climate change at basin and regional scales. The outcome of this workshop will be a chapter of the ICES position paper on climate change.
Resource requirements	The group will meet in Brussels. So there are not any special requirements from ICES Secretariat.
Participants	The Belgian Management Unit of the North Sea Mathematical Models will lead the organization of this workshop and will identify in collaboration with SSICC the adequate experts to cover all the different approaches and questions to be responded in the ToRs. The total number of experts attending this workshop is estimated to approx. 15 people.
Secretariat facilities	No special requirement from ICES Secretariat.
Financial	The workshop will be funded by the ICES SIF allocated to the SSICC. So this meeting is at ICES expenses.
Linkages to other committees or groups	The results of this workshop are relevant for many working groups interested in climate change.
Linkages to other organizations	Links with other organizations are already established as the coordination of this workshop will be responsibility of a group not involved in the ICES work.

2009/2/SSGEF05 The **Study Group on Climate related Benthic processes in the North Sea** (SGCBNS), chaired by S. Birchenough*, UK and H. Reiss*, Germany, will be established and will meet at CEFAS, Lowestoft, UK, 1–5 March 2010 to:

a) Review and consider a reduced spatial coverage (i.e. small-scale approach) for studying benthic processes outlined as during the Working group Climate related Benthic Processes in the North Sea (WKCBNS);

b) Develop a work plan within the timeframe of the Study Group for developing a comprehensive research proposal;

c) Initiate a benthos long-term series network in support of comparative studies on climate effects on the benthos across areas;

d) Initiate intercessional work by using case studies to explore wider patterns across benthic assemblages;

e) Explore collaborative opportunities with other ICES Expert Groups, for maximising the use of data sets;

f) Report by 15 March on potential contributions to the high priority topics of ICES Science Plan by completing the document named "SSGEF_workplan.doc" on the SharePoint site. Consider your current expertise and rank the contributions by High, Low or Medium importance;

g) Prepare contributions for the 2010 SSGEF session during the ASC on the topic areas of the Science Plan which cover: Individual, population and community level growth, feeding and reproduction; The quality of habitats and the threats to them; Indicators of ecosystem health.

SGCBNS will report by 15 April 2010 (via SSGEF) for the attention of SCICOM, ACOM and BEWG.

Supporting Information

Priority	The work of this Study Group (SG hereafter) will be in accordance to the recent ICES Science Plan in support of an Ecosystem Approach. Evidence-based science to advance our current knowledge with the facilitation of interdisciplinary research for assessing climate change processes for marine benthos and the integration of surveys to harmonise practices will be a valuable strategy to develop this work.
Scientific justification	Current public and scientific concerns on the climate-driven changes within marine ecosystems has stimulated much interest in how climate change might affect benthic organisms. Currently there is a lack of understanding in how benthic communities respond to climatic variation. The fact that marine benthic ecosystems are relatively complex and ecological processes, such as trophic and non-trophic interactions, benthic-pelagic coupling and species interaction, are only partly understood, emphasizes the need for enhanced research of climate influences on benthic communities and processes. Based on the work done in the BEWG and the SGNSBP on the assessment of effects of changes in hydrodynamics and sea temperature and changes of the distribution of benthic communities, respectively, this SG will address relevant open questions of climate related processes in benthic systems. During the WKCBNS meeting in 2008 several hypotheses on how climate change may affect benthic ecosystems were already developed. The aim of the Study Group "Climate related Benthic processes in the North Sea" [CBNS] will be build upon these discussions, with a view to outline and inititate relevant interdisciplinary research and strategies by using case studies to address hypotheses relevant for climate effects on benthic systems.

Resource requirements	No specific resource requirements beyond the need for members to prepare for and participate during the meetings.
Participants	These would include a wide range of scientists, whose disciplines could contribute to the topics developed in this SG (e.g. benthic ecology, fish ecology and ecological modelling). Additional participation will be sought from ICES countries and by scientists both from disciplines and scientific circles not normally represented at ICES when necessary. It has to be clear that - because of its high data availability - the North Sea is here selected as a case-study area, rather than the research focus, which is the impact of climate change to the benthos. Hence, any expert in this field of research – also from non-North Sea bordering countries might contribute to the SG.
Secretariat facilities	This group is likely to have demand on the computing resources of the Secretariat, but no additional software/hardware is anticipated beyond that which is currently available.
Financial	
Linkages to advisory committees	SCICOM and ACOM
Linkages to other committees or groups	A close working link with e.g. Benthos Ecology Working Group (BEWG), Science Strategic Initiative on Climate Change (SSICC), Working Group on Modelling of Physical/Biological Interactions (WGPBI), ICES Regional Ecosystem Group for the North Sea (REGNS) and ICES Working Group on Zooplankton Ecology (WGZE).
Linkages to other organizations	ICES will seek wider participation for this group including contact with relevant academic and intergovernmental organisations for this SG.

2009/2/SSGEF07 The **Working Group on Phytoplankton and Microbial Ecology** (WGPME), chaired by William Li*, Canada and Xosé Anxelu G. Morán*, Spain, will be established and will meet at the Marine Laboratory, Aberdeen, UK, 3–5 March 2010 to:

a) Develop an action plan to provide a primary focus for phytoplankton and other unicellular microbes within the ICES Science Plan.

b) Establish the conceptual and operational foundations for undertaking a comparative analysis of multiyear time series data of phytoplankton and microbial plankton.

c) Report to SSICC on the outcomes of the ASC 2009 Theme Session ("Trends in chlorophyll and primary production in a warmer North Atlantic").

d) Explore possible linkage to other related working groups within ICES (e.g. WGZE) and to those in other bodies (e.g. SCOR).

e) Prepare for a Theme Session at ICES ASC 2010 ("Ecological response of microbial plankton to global change processes in ocean basins, shelf seas and coastal zones").

f) Report by 15 March on potential contributions to the high priority topics of ICES Science Plan by completing the document named "SSGEF_workplan.doc" on the SharePoint site. Consider your current expertise and rank the contributions by High, Low or Medium importance;

g) Prepare contributions for the 2010 SSGEF session during the ASC on the topic areas of the Science Plan which cover: Individual, population and community level growth, feeding and reproduction; The quality of habitats and the threats to them; Indicators of ecosystem health.

WGPME will report by 15 May 2010 (via SSGEF) for the attention of SCICOM.

Supporting Information

Priority	The activities of this Group are related to issues of climate change, lower trophic level biodiversity, and ecological dynamics of coastal waters. Consequently, these activities are considered to have a high priority.
Scientific justification	ToR a) This project aims to fill the ecological gap between the abiotic environment (e.g. WGOH) and higher trophic levels (e.g. WGZE), providing the causal links to signals propagated from the bottom up and from the top down. ToR b) The work on this topic aims to address community change (structure, function, biodiversity) resulting from climate change, ocean acidification, eutrophication and other systemic pressures. ToR c) This assessment will contribute to the ICES position paper on climate change and to the work of SSICC. ToR d) This linkage may allow WGPME to leverage time series analysis undertaken by SCOR phytoplankton WG, or by others delivering products under existing framework directives on marine waters. ToR e) This Theme Session will assess the state of knowledge on multiyear change in phytoplankton and microbial communities, emphasizing the importance of microbial primary and secondary producers in marine ecosystems, both as foundational components and as conduits of systemic change. ToRs f) and g) This is a request from SSGEF.
Resource requirements	None.
Participants	The Group seeks participation by some 15–20 members.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to advisory committees	None.
Linkages to other committees or groups:	There are potential working relationships with WGOH, WGZE, WGHABD.
Linkages to other organizations	There is potential linkage to SCOR.

2009/2/SSGEF08 The **Working Group on Oceanic Hydrography** (WGOH), chaired by G. Nolan, Ireland; and H. Valdimarsson, Iceland, will meet in Brest, France, 9–11 March 2010 to:

a) Update and review results from Standard Sections and Stations;

b) Consolidate inputs from Member Countries to, and continue development of, the ICES Report on Ocean Climate (IROC), and align data source acknowledgements in IROC with ICES policy; archive data used to compile report;

c) Provide support to other Expert Groups requiring information on oceanic hydrography;

d) Take action for strengthening the role of WGOH and physical oceanography within ICES; such as IGSG and WGOOFE and explore areas of mutual interest with international climate monitoring programmes;

e) Provide expert knowledge and guidance to ICES Data Centre (possibly via subgroup) on a continuous basis;

f) Contribute to ICES Climate Change position paper including:
   a. Warming trends in the North Atlantic
   b. Sea ice cover changes in "hot spots" chapter
   c. Physical properties and circulation in the North Atlantic

g) Report by 15 March on potential contributions to the high priority topics of ICES Science Plan by completing the document named "SSGEF_workplan.doc" on the SharePoint site. Consider your current expertise and rank the contributions by High, Low or Medium importance;

h) Prepare contributions for the 2010 SSGEF session during the ASC on the topic areas of the Science Plan which cover: Individual, population and community level growth, feeding and reproduction; The quality of habitats and the threats to them; Indicators of ecosystem health.

WGOH will report by 30 April 2010 (via SSGEF) for the attention of SCICOM and ACOM.

Supporting Information

Priority:	The activities of this Group are fundamental to the work of the SGEF.
Scientific Justification	This is a repeating task established by the Working Group to closely monitor the ocean conditions in the ICES area. The materials presented under this item will be utilised to prepare an overview of the state-of-the-environment in the North Atlantic for 2009. The Working Group recognises the need for disseminating climate information in a timely and appropriate manner. This agenda item will allow WGOH members to prepare the document during the meeting, thus avoiding delays in the dissemination of the information. We will review proposed new developments in IROC content. Links have been made with the CLIVAR programme; it would be of benefit both to ICES and the international programmes to enhance internal information exchange. To follow up on the ICES General Secretary's suggestions for increasing the visibility of WGOH within ICES. To improve communications between working groups under the ICES system. This is in compliance with a request from the ICES Data Centre The work of the proposed Expert Group will be relevant for WGOH. ToRs g) and h) This is in response to a request from SSGEF.
Resource Requirements	No extraordinary additional resources
Participants	WGOH members; Chair of SGEF
Secretariat Facilities	N/A
Financial	
Linkages to Advisory Committees	ACOM
Linkages to Other Committees or Groups	Publications Committee; Consultative Committee; IGSG
Linkages to Other Organisations:	IOC, JCOMM, CLIVAR

2009/2/SSGEF09 The **Working Group on Cephalopod Fisheries and Life History (**WGCEPH), chaired by Graham Pierce, Spain, will meet at AZTI, Sukarrieta, Spain, 9–11 March 2010 to:

a) Update relevant fishery statistics (landings, directed effort, discards, etc) across the ICES area, and report on status and trends;

b) Review and report on innovative cephalopod research results in the ICES area, with particular emphasis on (i) studies on paralarval ecology and physiology and (ii) experimental studies on possible effects of climate change;

c) Review current approaches to cephalopod stock assessment and fishery management in North America and evaluate the feasibility of applying similar approaches in Europe;

d) Provide an overview of the outcomes of the current fishery (and survey) data collection programmes for cephalopods, with particular attention to (i) the success of the métier-based approach in relation to the previous fishery data collection system, (ii) utility of data currently collected for assessment purposes, and (iii) recommendations for improvements in the DCR and for any additional evaluation of the DCR that is thought to be needed;

e) Report by 15 March on potential contributions to the high priority topics of ICES Science Plan by completing the document named "SSGEF_workplan.doc" on the SharePoint site. Consider your current expertise and rank the contributions by High, Low or Medium importance;

f) Prepare contributions for the 2010 SSGEF session during the ASC on the topic areas of the Science Plan which cover: Individual, population and community level growth, feeding and reproduction; The quality of habitats and the threats to them; Indicators of ecosystem health.

WGCEPH will report by 10 May 2010 (via SSGEF) for the attention of SCICOM, ACOM (on ToRs c) and d)) and PGCCDBS (on ToR d)).

Supporting information

Priority	Cephalopods are important components of marine ecosystems but European cephalopod fisheries remain outside CFP quota controls. However, directed cephalopod fisheries, especially small-scale fisheries, are increasingly important and it is necessary to have in place a system of data collection and stock evaluation that is adequate to support management.
Scientific justification	Specific comments on the Terms of Reference are: ToR a) Monitoring of fishery trends remains basic to the work of the Group and to ensure that these fisheries remain sustainable. In the last few years submission of new fishery data to the WG by national fisheries laboratories has at best been patchy and the WG has relied on data supplied via ICES itself. ToR b) The future success of fishery forecasting and viable commercial aquaculture of these molluscs is fundamentally linked to understanding the physiology and ecology of the paralarvae. Current experimental studies are providing clear indications of the likely effects of climate change on cephalopods. Monitoring and reporting on research in these two areas is therefore important. ToR c) WGCEPH has been strongly focused on European cephalopod fisheries over the last two decades, fisheries which remain outside CFP quota control. However, several North American cephalopod stocks are a routinely assessed and it would be useful to evaluate whether approaches in use in the USA and Canada could be applied to European fisheries. ToR d) The revision of the national fishery data collection (DCR) programme for 2009 offers the prospect for improved data collection on

	cephalopods. However, there is a need to evaluate its effectiveness for this group as well as to examine the current status of survey data collection on cephalopods. It is important to determine whether the new DCR is delivering the information that is/would be needed to assess cephalopod stocks, and to identify any shortcomings. This is a non-trivial task and may well not be achievable by WGCEPH alone, given the resources available. The group therefore suggests that such an evaluation could be made the subject of a DG fisheries tender (and recommends that ICES takes this suggestion forward), in which case WGCEPH could participate in reviewing the outcomes of the work thus supported. ToRs e) and f) This is in response to a request from SSGEF.
Resource requirements	As noted in the 2009 report and previously, participation in WGCEPH is limited by availability of funding, especially as many members and potential members are university staff with no access to "national funds" for attendance at ICES meetings. One suggested solution was to propose this Group for addition to a list of groups eligible to be funded by the European Commission. The WG Chair is unfamiliar with this process and requests assistance/advice from ICES!
Participants	The Group is normally attended by around 15 members and guests, although with a strong bias towards participants from the Iberian peninsula. The number of attendees from Europe is likely to be substantially reduced if the meeting is held in the USA.
Secretariat facilities	None
Financial	
Linkages to advisory committees	Provision of information to SciCom and its satellite committees as required to respond to requests for advice/information from NEAFC and EC DG Fish.
Linkages to other committees or groups	None
Linkages to other organizations	None

2009/2/SSGEF10 The **Working Group on Seabird Ecology** (WGSE), chaired by Jim Reid, UK, will meet at ICES HQ in Copenhagen, Denmark, 15–19 March 2010 to:

a) Review the status of relevant seabird populations in relation to the OSPAR ecological quality objective (EcoQO) for seabird populations, and within the QSR 2010 and EU Marine Strategy Framework Directive contexts where appropriate;

b) Update and extend the review of studies of the distribution and habitat associations of seabirds in ICES waters based on remote tracking of individual birds;

c) Review progress towards a Community Plan of Action to reduce seabird bycatch in EU waters, and report any new data on fishing effort and seabird bycatch in these waters;

d) Explore the use of demographic, behavioural and physiological data as early warning systems of population change in seabirds;

e) Review the predicted interactions between parasites and climate change on seabirds;

f) Review and summarize the literature on foraging interactions among sea-birds, cetaceans, and predatory schooling fish, especially tuna, mainly in North Atlantic waters but with relevant material from all oceans;

g) Review methodological approaches applied in, and progress with, the identification of marine protected areas for birds in EU waters;

h) Report by 15 March on potential contributions to the high priority topics of ICES Science Plan by completing the document named "SSGEF_workplan.doc" on the SharePoint site. Consider your current ex-pertise and rank the contributions by High, Low or Medium importance;

i) Prepare contributions for the 2010 SSGEF session during the ASC on the topic areas of the Science Plan which cover: Individual, population and community level growth, feeding and reproduction; The quality of habitats and the threats to them; Indicators of ecosystem health.

WGSE will report by 20 April 2010 (via SSGEF) for the attention of SCICOM.

Supporting Information

Priority	This is the only forum for work being carried out by ICES in relation to marine birds. If ICES wishes to maintain its profile in this area of work, then the activities of WGSE must be regarded as of high priority. The response to part of ToR c) is needed to help fulfil ICES advisory MoU.
Scientific justification	All proposed Terms of Reference pertain directly to one or more of the high priority research topics contained in the three thematic areas of the ICES Science Plan. Term of Reference a) Convened in association with WGSE 2008, ICES WKSEQUIN recommended that WGSE review annually the status of selected seabird populations in the context of the EcoQO on seabird populations it has formulated. Development of the EcoQO was in response to a request by OSPAR, and was recommended by WGSE in 2001. For effective consideration of this proposed ToR, however, further development of the EcoQO would be necessary. The possibility exists for the EcoQO to serve as a model for similar initiatives under the OSPAR QSR 2010 report and biodiversity descriptors reporting under the EU MSFD. Term of Reference b) Identification of important seabird habitats is critically important for spatial planning and can help to identify Marine Protected Areas and area of common usage by seabirds and fisheries; tracking of individual birds using satellite tags and other data loggers is one of the most important sources of information available for this purpose. Term of Reference c) There is a standing request in the MoU with the European Commission for ICES to provide any new information on the impact of fisheries on other components of the ecosystem including seabirds. WGSE will assemble any such new information. The EC has been committed to producing a Community Plan of Action to reduce the incidental bycatch of seabirds in EU waters. Bycatch affects many species of seabird, including some critically endangered populations, but actual bycatch rates are not known with certainty for any species or regions. A crucial part of the Plan is to assess the extent of bycatch in all fishing gears. WGSE has recommended that fisheries effort data be made available for this purpose so that the proper analyses and application of the data be made. Term of Reference d) ICES WKSEQUIN recommended that WGSE review annually the status of selected seabird populations with regard to the EcoQO on seabird populations. Typically, there is a lag between environmental change and population change, so WGSE consider it useful to review intrinsic early

	warning systems of population change to provide more rapid assessments of environmental impacts. Term of Reference e) WGSE considers this issue to be of relevance because of current general interest in seabird-parasite interactions and in climate change in their own rights. However, the impact of parasites on the behaviour and demography of seabirds in the specific context of climate change is of growing interest to the research community since increasing temperatures are expected to have profound effects on host susceptibility, pathogen survival, and disease transmission. Term of Reference f) WGSE considers that a review of the feeding interactions and associations among top predators would be an important contribution to further understanding the ecosystem at a high trophic level, and would have policy-relevant applications in seabird, marine mammal and tuna conservation. Term of Reference g) WGSE first considered progress with marine Special Protection Area classification in 2003 and revisited the topic in 2006 and 2007. Since then, there has been rapid progress in application of novel techniques for identifying protected areas and also with classification of SPAs under the EC Birds Directive. In view of this and the higher profile being accorded ICES in the science behind implementation of European Directives, most recently the Marine Strategy Framework Directive, WGSE considers it timely to update its review of work aimed at identifying protected areas for birds at sea as required by the Birds Directive. Terms of Reference h) and i) This is in response to a request from SSGEF.
Resource requirements	Facilities for WGSE to work at ICES HQ are anticipated to be excellent.
Participants	Meetings of WGSE are usually attended by ca. 15 nominated and Chair-invited members. Although the Working Group should be able to achieve most of the above objectives, some members may not be able to attend through lack of funding. Funding of these members from Member Countries would be very welcome.
Secretariat facilities	Routine office and IT support at ICES HQ.
Financial	No financial assistance will be required for participation of nominated members of WGSE and venue costs. Funding of Chair-invited participants in the meeting would be very welcome.
Linkages to advisory committees	ACOM
Linkages to other committees or groups	WGSE is keen to continue the process of integration of seabird ecology into ICES.
Linkages to other organizations	EU, OSPAR, HELCOM

2009/2/SSGEF12 The **Working Group on Zooplankton Ecology** (WGZE), chaired by M. C. Benfield, USA, will meet in Portland, Maine, USA, 23–26 March 2010 to:

a) Review the outcomes of new initiative proposals and select one or more future initiatives based on a review of planning letters summarizing potential programs;

b) Review the work progress of the Study Group on Integrated Morphological and Molecular Taxonomy;

c) Review the progress of the ICES historical dataset digitization project, new enzymatic and size-classed methods for zooplankton, and the outcome of the 2009 ASC Session A;

d) Prepare and improve the ICES Plankton Status report including an examination of regional and cross-basin trends and recommend means of incorporating species information into the report;

e) Review plans for sessions and activities during the 5th Zooplankton Production Symposium;

f) Review the report on Zooplankton and Climate Change for the ICES Position Paper on Climate Change and revise as necessary based on comments from the SSICC; and

g) Discuss potential linkages and encourage joint activities with the Working Group on Phytoplankton and Microbial Ecology;

h) Monitoring methodologies for ocean acidification (OSPAR request 2010/2): To provide, on the basis of a review of existing methodologies and experience, recommendations for cost efficient methods for monitoring ocean acidification (OA) and its impacts, including possibilities for integrated chemical and biological monitoring. Specifically this should provide:

   i. advice on appropriate spatial and temporal coverage for monitoring, considering different oceanographic features and conditions and key habitats/ecosystems at risk from OA in the OSPAR maritime area;

   ii. advice on the status and maturity of potential indicators of OA impacts, on species, habitats and ecosystems that could be considered for inclusion in OSPAR monitoring programmes.

i) Report by 15 March on potential contributions to the high priority topics of ICES Science Plan by completing the document named "SSGEF_workplan.doc" on the SharePoint site. Consider your current expertise and rank the contributions by High, Low or Medium importance;

j) Prepare contributions for the 2010 SSGEF session during the ASC on the topic areas of the Science Plan - which cover: Individual, population and community level growth, feeding and reproduction; The quality of habitats and the threats to them; Indicators of ecosystem health.

The WGZE will report by 1 May 2010 (via SSGEF) for the attention of SCICOM and ACOM.

SUPPORTING INFORMATION

Priority	The activities of this group are a basic element of the SSG, fundamental to understanding the relation between the physical, chemical environment and living marine resources in an ecosystem context. Reflecting the central role of zooplankton in marine ecology, the group members bring a wide range of experienced expertise and enthusiasm to bear on questions central to ICES concerns. Thus the work of this group must be considered of very high priority and central to ecosystem approaches.
Scientific justification	Term of Reference a) Current possibilities for future projects/initiatives include: updating the

zooplankton methodology manual, a seagoing high-tech zooplankton ecology workshop, developing a means to sustain and strengthen taxonomic capability and to integrate new and traditional taxonomic tools into zooplankton ecology, developing a study to determine the physiological tolerances and factors that determine the ranges of species including mining and extending the Plankton Status Report.

The WGZE has a strong history of practical, intersessional projects with broader and lasting outcomes. For example, the ICES Zooplankton Methodology Manual was a major achievement of the WGZE and is in need of updating. A second seagoing workshop would enable high-tech zooplankton ecology approaches to be evaluated. The WGZE has actively supported training in new and traditional taxonomic tools. Determination of the physiological tolerances and the factors that determine the ranges of zooplankton species is key to a better understanding of the responses of zooplankton to climate variability and change in the ICES area.

Term of Reference b)

The WGZE has actively supported training in new and traditional taxonomic tools and has a strong interest in this wider proposal. Given the WGZE's active interest in defending taxonomic skills in the ICES region, this WG is ideally-situated to provide a positive supporting role in assessing taxonomic methods, information, and potential new techniques by coordinating and promoting developments and information feed-back to the scientific community who support ICES data provision, analyses, and advice. ICES as a stable, long lived and international institution has a major role to play in the collation, review, and application of these efforts, in promoting best practices and in coordinating development and dissemination of such information.

Term of Reference c)

All three topics are initiatives of the WGZE and it is appropriate that the WG monitors their progress and evaluates their outcomes.

For the Dataset Digitization Project, the WGZE recognizes the importance of making available and analyzing older time series data so that the information they contain can be compared with more recent material. This is especially important in our present era of recognized changes in climate, plankton and fisheries. Long-term time series of plankton from the North Atlantic are relatively rare and further they tend not to extend very far back in time. The project for the digitization, analysis and interpretation of plankton data for pre-1914 ICES sampling in the North Sea and adjacent waters will rescue a unique historical dataset from the turn of the last century. Against this background, the group feels it is important to monitor the success of the project.

Recognizing that the more traditional approaches to measuring zooplankton feeding and growth rates are hampered with weaknesses, the WGZE feels as important to monitor new approaches based on new enzymatic and size-classed methods.

Theme Session A for the 2009 ASC, 'Biochemical, biogeochemical, and molecular approaches to the study of plankton ecology and species diversity', will be a major international event. The outcomes will be important to the future aims and plans for plankton research. As the proposers of this Theme session we would like to follow up on progress made in this event.

Term of Reference d)

This is a repeating task established by the Working Group in 2000 to monitor the plankton abundance in the ICES area. The material presented under this item updates and expands the annual Summary Plankton Status Report in the ICES area. Reported results are significant observations and trends based on a wide range of time-series sampling programmes. Efforts are in hand to expand the report spatially and to include phytoplankton and elementary physics and to facilitate comparative analyses and setting monitoring standards and recommendations.

Term of Reference e)

As one of the organizers of the upcoming 5th Zooplankton Production

	Symposium, WGZE feels committed to contribute to its success. The symposium will be a major international event, the outcomes of which will be important to the future aims and plans for plankton research. The WGZE has a good practical history of sponsoring, running and organizing past Zooplankton Production Symposia. The successful organization of the Symposium is essential to successful collaboration with other sponsors and to its success. Term of Reference f) This is an important input from the WGZE to the ICES Position Paper and it will be timely to review progress and comment as appropriate. Having contributed a draft chapter for the ICES Position Paper on Climate Change, which will include substantial evidence that zooplankton abundance and distributions are being strongly impacted by climate change, the WGZE would like to consider the responses of SSICC and provide feedback. Term of Reference g) The potential formation of this new WG is of great interest and significance for the WGZE. Moreover, the WGZE supports the initiative and looks forward to joint activities that will facilitate an ecosystem based approach. Given that microzooplankton constitute a significant component of the plankton community in many marine environments, and owing to their small size, they typically have higher weight-specific growth rates than larger metazoans. Consequently, they are important phytoplankton grazers in many marine systems, capable of exploiting pico- and nanoplankton. Microzooplankton may in turn be eaten by larger metazoans of the plankton community and thus they form an important link in the "microbial loop" between pico- and nanoplankton and higher trophic levels. Due to lack of proper methodology for collection, preservation and difficulties in identification, their ecology is relatively poorly understood. With all this in mind WGZE members feel it is important to follow progress towards the establishment of a Working Group devoted to Microbial Ecology. Term of Reference h) This is an OSPAR request which is also adressed by MCWG and WGDEC and WGZE is invited to contribute with relevant aspects. Terms of Reference i) and j) This is in response to a request by SSGEF.
Resource requirements	Resource required to undertake the activities of this group is negligible. However, ICES must be committed to provide some sponsorship and support for workshops, publication costs for the Plankton Status Report, and the 5th Zooplankton Symposium.
Participants	The group has an enthusiastic core membership, and is successfully making efforts to attract broader participation both across ICES nations and across relevant skills. The WGZE Annual Meeting is normally attended by some 20–25 members and guests.
Secretariat facilities	None, beyond communication support.
Financial	
Linkages to advisory committees	The Group reports to SCICOM and ACOM. Mainly WGZE provides scientific information on plankton and ecosystems and welcomes input from other committees , working/ study groups etc.
Linkages to other committees or groups	Any and all working and study groups interested in marine ecosytem monitoring and assessments, modelling and/or plankton studies, including fish and shellfish life histories and recruitment studies. Strong working links have been developed between WGZE and Mediterranean colleagues (CIESM), and with the Census of Marine Zooplankton (CMarZ) and SCOR WG130: Automatic Visual Plankton Identification.
Linkages to other organizations	

2009/2/SSGEF13 The **Workshop on Understanding and quantifying mortality in fish early-life stages: experiments, observations and models** (WKMOR), chaired by A. Gallego*, UK, E. North*, USA and E. Houde*, USA, will meet in Aberdeen, Scotland, UK, 22–24 March 2010 to:

a) Review current and emerging laboratory, mesocosm, field and modelling methodology aimed at understanding the underlying mechanisms that control mortality during fish early-life stages;

b) Summarize the state of our understanding of the mechanisms that control mortality of fish eggs, larvae and juveniles, identify information gaps, and list future research directions as proceedings from the workshop;

c) Develop recommended techniques to quantify mortality in the field and model its impact on subsequent recruitment.

WKMOR will report by 15 May 2010 (via SSGEF) for the attention of SCICOM.

Supporting Information

Priority	This workshop will bring together state-of-the-art knowledge about a process which is critical for the understanding of recruitment in marine fish.
Scientific Justification	The Workshop contributes to the new ICES Stategic Goal #3 that ICES should lead the development of methods and tools needed in support of operational ecosystem observation services, in order to improve the understanding of climate change and impacts to our oceans and marine ecosystems. The topic of fish early-life mortality has been the subject of considerable research. Nevertheless, it is still considered one of the main topics where substantial progress remains to be made (see WKAMF Report). With the development of new laboratory and field observational techniques, and the advance of modelling methodology, it is time to review approaches for estimating, simulating, and improving our understanding of the processes that control mortality. The workshop goal is to develop recommended practices for quantifying mortality in the field (e.g. accounting for advection/diffusion effects) and for constructing process-based foracasting tools that quantitatively link spawning stock biomass/egg production and post-juvenile stages. The proposed workshop will focus on technical and methodological issues, important physical-biological processes (inc. density-dependence), and on future research needs. This workshop will foster information exchange between international organizations such as ICES and PICES. The workshop, and the international collaboration that result from it, will advance the application of cutting-edge modelling approaches to issues that are critical for fisheries management such as understanding fish recruitment variability.
Resource Requirements	The research programmes which provide the main input to this group are already underway, and resources already committed. The additional resource required to undertake additional activities in the framework of this group is negligible.
Participants	This Workshop should attract 25–50 participants and will include some scientists from outside the regular ICES scientific community. We plan to identify participants during the 2009 ASC Theme Session proposed by WGPBI entitled "Death in the sea – Mortality in the zooplankton and early-life stages of marine fish (estimates, processes and outcomes)". We also will invite participation from ICES groups with an interest in physical-biological interactions and fish recruitment processes (e.g. WGRP, WGZE, WGFE) and from groups such as GLOBEC and PICES.
Secretariat Facilities	None
Financial	No financial implications

Linkages To Advisory Committees	Relevant to the work of the advisory structure.
Linkages To other Committees or Groups	WGRP, WGZE, WGFE

2009/2/SSGEF14 The **Working Group on Modelling of Physical/Biological Interactions (**WGPBI), chaired by U.H. Thygesen, Denmark, and E. North,* USA, will meet in Aberdeen, Scotland, UK, 25–26 March 2010 to:

a) Discuss and evaluate new results concerning physical/biological interactions;

b) Review and assess the results of WKMOR and plan publications and other follow on activities;

c) Publish a review of the physiological attributes of early life stages of marine fish species relevant for projecting climate-impacts using coupled hydrodynamic biophysical models;

d) Report on recent advances in models and observations of physical and biological processes at scales below the Rossby radius;

e) Report on developments in linking physical models, biogeochemistry models, and higher trophic level models, and disseminate information on common metadata standards needed for linking these models;

f) Assess progress on the book "Individual-based modelling of organisms within aquatic ecosystems: coupling biology with hydrodynamics";

g) Prepare for ASC Theme sessions on 'Combining models of the full life cycle of fish with lower trophic models: integration and prediction' and 'Physics and biology in modelling HABs: validation and application to forecasting and climate change;

h) Prepare for Workshop on Mapping Potential Fish Habitat using Physical/ Biological Models convened by Petitgas and Peck;

i) Prepare for joint meeting with WGHABD in 2011;

j) Report by 15 March on potential contributions to the high priority topics of ICES Science Plan by completing the document named "SSGEF_workplan.doc" on the SharePoint site. Consider your current expertise and rank the contributions by High, Low or Medium importance;

k) Prepare contributions for the 2010 SSGEF session during the ASC on the topic areas of the Science Plan which cover: Individual, population and community level growth, feeding and reproduction; The quality of habitats and the threats to them; Indicators of ecosystem health.

WGPBI will report by 30 April 2010 (via SSGEF) for the attention of SCICOM.

Supporting Information

Priority	The WG should be given high priority, since it is concerned with the evaluation and development of the modelling tools used to increase the understanding of the interaction between the living resources in the sea and its ambient physical and abiotic environment. This understanding is essential to the successful development of predictive capability of the state and evolution of the ecosystem for issues such as harmful algal booms, eutrophication, marine protected areas,

	fish recruitment, and global change. This contributes directly to fulfilling the vision of ICES, "to improve the scientific capacity to give advice on the human impact on, and impacted by, marine ecosystems." The work of WGPBI contributes to ICES Strategic Goal #3: "ICES should lead the development of methods and tools needed in support of operational ecosystem observation services in order to improve the understanding of climate change and impacts to our ocean and marine ecosystems."
Scientific justification	a) Providing a forum for the presentation and discussion of new results is an important component of the Group's mandate. b) The larval fish subgroup identified mortality as the top priority topic; it is critical for the understanding of recruitment in marine fish. To address this issue the Workshop on Mortality (WKMOR) will be held in Aberdeen, Scotland, on 22–24 March 2010. The workshop goal is to develop recommended practices for quantifying mortality in the field (e.g. accounting for advection/diffusion effects) and for constructing process-based forecasting tools that quantitatively link spawning stock biomass/egg production and post-juvenile stages. This workshop will foster information exchange between international organizations such as ICES and PICES. Papers from the Workshop will be published in a theme section of a journal. Research Themes: Operational Ecosystem Modelling and Life History. c) Ocean temperatures are expected to increase with global warming and the physiology of marine fish is sensitive to temperature changes. A comprehensive review of the physiological parameters required to create mechanistic foraging and growth subroutines for marine fish early life stages is needed to: 1) identify gaps in knowledge and highlight research needs to funding agencies; 2) calculate confidence limits to model-derived estimates of changes in vital rates (e.g., growth, survival); and 3) search for (and possible reveal) common physiological traits allowing generic models to be created and projections made concerning climate impacts on the potential habitats of a broader range of fish species. Research Themes: Climate Change Predictions and Coastal Habitat. d) Understanding and describing the interactions between physics and HABs requires understanding physical processes on scales smaller than oceanographers commonly work. A review of recent advances in models and observations of physical and biological processes at scales below the Rossby radius (layers (1 m) in the vertical and 1–10 km in the horizontal) would be very useful as part of the next joint meeting with WGHABD. e) The next frontier in modelling physical biological interactions involves linking together physical models, biogeochemistry models, and higher trophic level models. This substantial technical challenge is central to the EU project MEECE (Marine Ecosystem Evolution in a Changing Environment). The development and wide spread acceptance of common metadata standards will be crucial for making this work. Research theme: Operational Ecosystem Modelling. f) WGPBI supports Sarah Hinckley (WGPBI member) and co-authors Bern Megrey and Al Hermann in their proposal to write a book tentatively titled "Methods for spatially-explicit individual-based modeling of marine organisms: coupling of biology with hydrodynamics." A high level of sophistication has been achieved with these types of models, however, there is little information available on how to determine if they are appropriate for a given problem, how to use them to address theoretical or applied problems, how to construct them, and how to test, validate and analyze them. They propose to remedy this deficiency. The book was inspired by the WKAMF Manual of Recommended Practices. Research themes: Life History and Operational Ecosystem Modelling. g) Succesful theme sessions at the ASC is considered an important output of the group. In 2010, the proposed theme session on 'Combining models of the full life cycle of fish with lower trophic models: integration and prediction' targets the important issue of coupling fish with their environment. The proposed

	session on "Physics and biology in modeling harmful algal blooms (HABs): validation and application for forecasting and climate change" targets HABs, a great concern because of their toxicity and/or the damage they cause to ecosystems and coastal resources. Key challenges are: (i) understanding the physiological/biological/environmental factors that regulate HABs, (ii) forecasting HAB events and (iii) assessing the impact of climate change on HABs (occurrence/frequency/magnitude). This theme session will bring together modellers and experimentalists to review modeling studies, laboratory and experimental research, field studies and remote sensing investigations that advance our ability to understand the underlying physical/biological interactions that control HABs, to improve HAB model validation, to forecast HAB events, and to assess effect of climate change. Research Themes: Operational Ecosystem Modelling and Climate Change Predictions. h) The Workshop on Mapping Potential Fish Habitat using Physical/Biological Models will build on the successful Workshop on Indices of Mesoscale Structures (WKIMS). It will incorporate the ongoing activities of WGOOFE (Working Group on Operational Oceanographic Products for Fisheries and Environment, Mark Dickey-Collas and Morten Skogen) and be a joint workshop. One theme will be the use of outputs from hydrodynamic / NPZD hindcasts to force fish models (directly) or to build environmental indices that can be used as co-variates for analyzing fish-environment relationships (distribution of stocks, vital rates of individuals, etc.). The workshop will utilize the knowledge gained in the review proposed in ToR c). Research Themes: Life History andCoastal Habitat. i) Provisional ideas for a two day joint meeting include presentations in the morning and discussions in the afternoon with the first day focusing on small scale physical processes (think layers (1 m) in the vertical and 1–10 km in the horizontal) and the second day focusing on modeling, HABs and climate change. WGOOFE may also be interested in participating. Research Themes: Operational Ecosystem Modelling, Life History, Climate Change Predictions and Coastal Habitat. j) and k) This is in response to a request from SSGEF.
Resource requirements	None
Participants	The WG is normally attended by some 20–30 members and guests. The Working Group benefits from the participation of those outside of the modelling community. Observational and experimental scientists with an interest in physical/biological interactions are encouraged to attend.
Secretariat facilities	None
Financial	No financial implications.
Linkages to advisory committees	ACOM
Linkages to other committees or groups	WGHABD, WGRP, WGZE
Linkages to other organizations	The work of this group is closely aligned with similar work in GEOHAB (IOC/SCOR), GLOBEC (IOC/SCOR), IMBER and PICES.

2009/2/SSGEF15 The **Benthos Ecology Working Group** (BEWG), chaired by Steven Degraer, Belgium, will meet in Edgewater, MD, USA, 19–23 April 2010 to:

a) Finalise and adopt the BEWG contribution to the ICES Position Paper on Climate Change;

b) Consider the status of the intercessional BEWG work on long-term data series analyses with special attention to climate change and to decide on future actions;

c) Consider the outcome of the Study Group on Climate-Related Processes within the Benthos of the North Sea and to formulate recommendations regarding its future actions;

d) Report on exciting developments in ongoing phyto- and zoobenthic research in the ICES area, with special attention to North-American activities;

e) Consider the status of the BEWG viewpoint paper on benthic indicators and evaluate ongoing developments on ecological quality assessment;

f) Explore the feasibility and added value of a Study Group on Habitat Suitability Modelling as an "interface" between BEWG and WGMHM and recommend future actions;

g) Report by 15 March on potential contributions to the high priority topics of ICES Science Plan by completing the document named "SSGEF_workplan.doc" on the SharePoint site. Consider your current expertise and rank the contributions by High, Low or Medium importance;

h) Prepare contributions for the 2010 SSGEF session during the ASC on the topic areas of the Science Plan which cover: Individual, population and community level growth, feeding and reproduction; The quality of habitats and the threats to them; Indicators of ecosystem health.

BEWG will report by 15 May 2010 (via SSGEF) for the attention of SCICOM.

Supporting Information

Priority	The current activities of this Group will lead ICES into issues related to the ecosystem affects of fisheries, especially with regard to the application of the Precautionary Approach. Consequently, these activities are considered to have a very high priority.
Scientific justification	Term of Reference a) A vast amount of scientific literature on the impacts of climate change on the benthos exists. A concise overview of what is know, what is not known and where to put future emphasis is however still lacking. This BEWG publication will contribute to the ICES Position Paper on Climate Change (due by end 2010) as initiated by SSICC. Term of Reference b) Evaluating the intercessional analyses of long-term data series will help identifying major ecosystem regime shifts, including their geographical spread, as starting point for further consideration of the impact of climate change onto the benthos. Term of Reference c) To ensure a proper follow-up of the SGCBNS (SG proposal in Annex 7) by the BEWG, an open discussion on the SGCBNS' future is needed. This will also help to attract scientists from outside the North Sea bordering countries to get involved in this initiative. SGCBNS focuses on climate-related processes in relation to climate change, taking the North Sea only as a case-study. ICES Science Plan, Priority 2: "Understanding interations of human activities with ecosystems" Various Research topics Term of Reference d) This is a prerequisite for the scientific information status of the group Term of Reference e)

	This viewpoint paper on benthic metrics will help to incorporate the lessons-learned from the WFD into the MSFD. ICES Science Plan, Priority 3: "Development of options for sustainable use of ecosystems" Various Research topics Term of Reference f) Habitat suitability modelling (HSM) helps understanding the distribution of species and communities. As such, it helps elaborating a scientifically-sound management of the marine ecosystem. Two EGs are currently embracing HSM, namely the BEWG and the SGMHM. To maximize the use of human resources in HSM, clear agreements between both EGs are needed. Terms of Reference g) and h) This is in response to a request by SSGEF.
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.
Participants	The Group is normally attended by some 20–25 members and guests.
Secretariat facilities	None.
Financial	No financial implications.
Linkages to advisory committees	There are linkages to ACOM.
Linkages to other committees or groups	There is a close working relationship with WGMHM, WGECO, WGEXT, MHC
Linkages to other organizations	MARS

2009/2/SSGEF18 The **Study Group on Integrated Morphological and Molecular Taxonomy** (SGIMT), chaired by Steve Hay*, UK, will be established and will work by correspondence in 2010 to:

a) Identify resources, current gaps, and important issues in taxonomic research;

b) Provide a platform for promotion and exchange of relevant scientific information;

c) Initiate and support provision of standards, training materials, and taxonomy workshops;

d) Assist in the revision and development of species identification keys;

e) Develop the continuing integration of molecular and morphological taxonomy;

f) Advise on the implications of developments for marine science and management.

g) Provide recommendations on approaches for the effective and broad dissemination of knowledge developed by the expert group, including estimates of resource requirements;

h) Report by 15 March on potential contributions to the high priority topics of ICES Science Plan by completing the document named

"SSGEF_workplan.doc" on the SharePoint site. Consider your current expertise and rank the contributions by High, Low or Medium importance;

i) Prepare contributions for the 2010 SSGEF session during the ASC on the topic areas of the Science Plan which cover: Individual, population and community level growth, feeding and reproduction; The quality of habitats and the threats to them; Indicators of ecosystem health.

SGIMT will report by 15 June 2010 (via SSGEF) for the attention of SCICOM and WGZE.

SUPPORTING INFORMATION

Priority:	The work of the Group is essential if ICES is to progress the developments of techniques in fish stock assessment.
Scientific justification:	The WGZE recognizes taxonomy as a fundamental discipline in general and evolutionary biology, ecology and environmental management. Taxonomy is critical to successful understanding, assessment and management of the species diversity and relationships in undisturbed ecosystems and in those affected by natural or human activities such as climate change/ acidification, industrial pressures or eutrophication. The group are also aware that there are globally increasing efforts to reverse the decline in marine taxonomic expertise and to advance traditional morphology-based phylogenies into the new frontiers opened up by molecular genetics. Indeed the WGZE has sponsored and arranged plankton taxonomic workshops and has strong associations with several of these global initiatives. Taxonomic experts are relatively few in many but not all ICES nations and they tend to specialise in certain taxa rather than generally across the diversity of plankton species. The current series editor (Steve Hay) presented the WGZE with a summary of his ICES Plankton ID series editor's report for 2008. This report looked at the background, recognised extensive difficulties with the series and commended ICES historical work in making the sheets available as web downloads and on CD. The report recommended several actions that ICES could pursue to take forward their support for taxonomy of marine plankton. These were discussed. The WGZE considered that the existing sheets, although many are outdated, are still a resource that is widely used and appreciated and they must remain available. Also, although those outdated sheets could be revised or redone this is unlikely to happen; as the format and production are outdated by the very many internet based approaches. Indeed the ICES web pages should carry warnings to users that in these historical ICES classifications the nomenclature may be out of date and names of species identified using the sheets should be checked for synonymies with such as the World or European Registers of Marine Species or ITIS. ICES major role is the collation, archiving, and dissemination of scientific data, analyses and evidence based advice to support policy making, regulatory control and the conservation and sustainable use of marine resources and ecosystems. ICES facilitates international collaborative science to achieve these aims. The WGZE consider that ICES has critical supporting and training roles in global marine science, through promoting scientific standards, new research and developments and training opportunities. Taxonomic standards and descriptions are subject to constant change and development. Particularly, taxonomy grows with new molecular approaches to species phylogeny, evolution, species adaptive capacities, environmental sensitivities and community diversity. These are highly significant new developments that in a few years will have revolutionised the monitoring and study of marine species and ecosystems. The WGZE consider it essential that ICES

	adopts a positive supporting role in assessing taxonomic methods, information and potential new techniques by coordinating and promoting developments and information feed-back to the scientific community who support ICES data provision, analyses, and advice. Considering the plethora of internet and other developments in taxonomic information, the WGZE considered it unlikely that ICES could or should develop its own web served database of taxonomic information. However, the majority of existing efforts are short-term funded and evolve through multiple and often uncoordinated short term efforts. Even major programs such as CoML and CMarZ or the EU MARBEF network have limited lifespans and have problems conserving and developing the gains they have made. Collectively and specifically these global efforts on traditional and molecular taxonomy amount to a valuable basic and developing resource. ICES as a stable, long lived and international institution has a major role to play in the collation, review, and application of these efforts, in promoting best practices and in coordinating development and dissemination of such information. ToRs h) and i) This is in response to a request from SSGEF.
Resource requirements:	No specific resource requirements beyond the need for members to prepare for and participate in the meeting.
Participants:	These should be drawn from relevant ICES expert groups (e.g. WGZE, WGHABD, WGFE, WGBE) and others within ICES member countries.
Secretariat facilities:	This group should be provided with an ICES web portal and SharePoint facility to enable communication and dissemination of their findings and expertise with ICES expert groups and more widely.
Financial:	None specific.
Linkages to advisory committees:	
Linkages to other committees or groups:	SCICOM
Linkages to other organizations:	

2009/2/SSGEF23 The **Working Group on Small Pelagic Fishes, their Ecosystems and Climate Impact** (WGSPEC), chaired by Jürgen Alheit*, Germany, will be established and will meet in Cadiz, Spain, on 20 January 2010 back-to-back with the EU Project FACTS to:

a) Prepare for a workshop to analyze the impact of climate on ecosystems in which small pelagic fishes such as herring, sardine, anchovy, sprat and capelin play an important role,

b) Suggest relevant joint theme sessions and workshops for ICES and PICES which are also relevant to ICES assessment working groups on pelagic fish.

c) Report by 15 March on potential contributions to the high priority topics of ICES Science Plan by completing the document named "SSGEF_workplan.doc" on the SharePoint site. Consider your current expertise and rank the contributions by High, Low or Medium importance;

d) Prepare contributions for the 2010 SSGEF session during the ASC on the topic areas of the Science Plan which cover: Individual, population and community level growth, feeding and reproduction; The quality of habitats and the threats to them; Indicators of ecosystem health.

WGSPEC will report by 31 March 2010 (via SSGEF) for the attention of SCICOM.

Supporting information

Priority	This Working Group has a high priority because the impact of climate variability on small pelagic fishes and their ecosystems has been largely ignored, as ICES had put its focus on climate studies of larger predatory fish (cod) and more northern ecosystems. The formation of this new Working Group is a support action for the new Strategic Initiative for Climate Change (SSICC) of ICES. This Working Group is an ideal vehicle to continue and strengthen collaboration with PICES which has been successfully started some years ago in the field of small pelagics and climate by joint workshops and theme sessions.
Scientific justification	Small pelagic fishes comprise about one third of the world's annual catch and play an in important role in most coastal and shelf sea ecosystems in the ICES area. They are very sensitive to climate variability and serve as early indicators for ecosystem changes. They have usually a prominent position as predators and prey in ecosystems. All this makes them ideal targets for climate studies. Their sensitivity to climate impact particularly evidenced by spectacular population crashes and rises demonstrates clearly the need to consider climate impacts in fisheries management. c) and d) This is a request from SSGEF.
Resource requirements	Not required
Participants	The participants of this Working Group should represent different disciplines such as fisheries science, planktology, physical oceanography, climatology.
Secretariat facilities	As usual for working groups.
Financial	Travel support to attend joint ICES/PICES theme sessions when organized in the PICES area should be sought through the funding made available by SCICOM on PICES invitation.
Linkages to other committees or groups	The Working Group will link up with other ICES groups such as SSICC, WGOH, WGZE, WGFE and ACOM, particularly in the planning of relevant workshop themes and theme sessions.
Linkages to other organizations	The Working Group will seek close cooperation with other international organisations, particularly from the North Pacific (PICES) and the Mediterranean.

2009/SSGEF/2/24 The **Working Group on Fish Ecology** (WGFE), chaired by Dave Kulka, Canada, will meet in Sète, France, 6–10 September 2010 to:

a) Present new results on modelling the interacting effects of climate and fisheries on productivity and community structure, including spatial aspects"

b) Review and evaluate metrics to characterize, monitor and detect changes in the structure, function and productivity of fish communities;

c) Develop, explore and apply mapping and other spatial methods for comparing and summarizing fish and fish community distributions in relation to environment and habitat;

d) Examine abundance/distribution relationships within species, and groups of species in different ecosystems in relation to habitat, environment and in relation to anthropogenic impacts;

e) Evaluate fluctuations within fish communities:

i. What constitutes regime shifts in fish communities? Can mechanisms be identified detected?

ii. State changes - Cycles vs. regime shifts

iii. Are anthropogenically induced changes alterable?

f) Report by 15 March on potential contributions to the high priority topics of ICES Science Plan by completing the document named "SSGEF_workplan.doc" on the SharePoint site. Consider your current expertise and rank the contributions by High, Low or Medium importance;

g) Prepare contributions for the 2010 SSGEF session during the ASC on the topic areas of the Science Plan which cover: Individual, population and community level growth, feeding and reproduction; The quality of habitats and the threats to them; Indicators of ecosystem health.

Long-term Term of Reference

h) Examine climate change processes and predictions of impacts.

WGFE will report by 15 October 2010 (via SSGEF) for the attention of SCICOM and ACOM.

Supporting Information

Priority	Link to 2009 Terms of Reference (see Annex 1)
Scientific justification and relation to the 16 high priority topics (hpt) of the Science Plan and Strategic Initiatives (SI)	This ToR is a more general phrasing of the traditional WGFE work on indicators of fish community structure, dynamics, production and function and human and climate impacts. This ToR relates to Science plan theme area 1 particularly, especially high Priority Topics (HPT) points 1,3,4,5. Additionally HPT 8 WGFE is continues to develop and test new community and biodiversity indicators in support of an ecosystem approach to management. ToR B is data part of the modelling work described in ToR a. ToR b therefore in relevant to the same sections of the science plan in addition to HPT 7. This work also has direct relevance to the Strategic Initiative on Biodiversity. Objective methods for comparing maps is an essential topic for examining changes in fish distributions in relation to forcing such as climate and fishing effort. Thus, this work could be important in future for SSICC and HPT 1. Sophisticated objective mapping tools are essential in developing strategies for marine spatial planning and therefore relevant to SICZSP and HPT 15. Changes in spatial distribution of fish in relation to external (climate, fisheries, habitat) and internal (density-dependence) forces and the separation of the two remains and important research area in WGFE. This work relates to HPT 2, 3, 5,8,11. This work can provide some theoretical back for work on marine spatial planning especially regarding sensitivity of species groups to habitat destruction and fragmentation with is important for SICZSP. This ToR is an open call to examine the concept of regime shift (and like processes) in marine fish communities. Considerable confusion and contention revolves around this issue currently and WGFE has a range of expertise that may be able to shed light on this work. This work relates to most topics under the Ecosystem Function thematic area and HPTs 8, 16. Because there is considerable interest and expertise on this topic in academia, it is hoped that this ToR may be an incentive for this segment of the research community to attend in greater numbers.
Resource requirements	
Participants	The group is normally attended by 15–20 members and guests.

Secretariat facilities	None.
Financial	No financial implications.
Linkages to SCI-COM steering groups	SSGEF, SSGSUE, SSGHIE, SSGESST
Linkages to other groups	Work on simulation in fish communities for the testing of EcoQOs is closely related to the development of multispecies modelling in WGSAM. EcoQO work is an important component of advice provided by ACOM. The work of this group is an important information source for WGECO (Ecosystem Effects of Fishing). This group has provided key scientific products to the Strategic Initiative on Climate Change (SSICC).
Linkages to other organizations	Work on indicator modelling and specifically EcoQO projections are the result of OSPAR requests to ICES.

SSGRSP Terms of Reference 2009

2009/2/SSGRSP03 The **Working Group on the Northwest Atlantic Regional Sea** (WGNARS), chaired by Steve Cadrin*, USA, and Alain Vezina*, Canada, will be established and will meet in Woods Hole, USA, 20–22 April 2010 to:

a) Initiate the development of an integrated assessment of the Northwest Atlantic region to support ecosystem approaches to science and management;
b) Develop a framework of coordinated ocean observation systems in the Northwest Atlantic region to support an integrated assessment of climate change and its effects on the marine ecosystem;
c) Develop a framework for compilation and synthesis of ecosystem survey data throughout the Northwest Atlantic region to support the assessment of biodiversity and climate impacts;
d) Develop an integrated approach to conservation of coastal habitats to support place-based ecosystem management;
e) Propose objectives and governance structure within the ICES Regional Sea Programme.

WGNARS will report by 25 May 2010 (via SSGRSP) for the attention of SCICOM.

Supporting information

Priority	A regional approach to marine science is essential to address high priority research topics in the ICES Science Plan associated with understanding ecosystem functioning, particularly climate change processes, biodiversity and the role of coastal-zone habitat in ecosystem dynamics.

Scientific justification	The establishment of a regional seas programme would address priority scientific issues in the Northwest Atlantic with wider implications over the ICES community. An integrated approach to marine science and management requires coordinated observations, modeling and assessments over the scale of the ecosystem. Ecosystem structure is hierarchical with connections between larger and smaller spatial scales. At the scale of the Northwest Atlantic Ocean, fisheries management is already coordinated between the USA and Canada in the Gulf of Maine as some fishery stocks are trans-boundary. In addition, the North Atlantic Fisheries Organization (NAFO) provides management advice for fisheries outside of the jurisdiciont of North American countries. Integrated approaches will require greater coordination and cooperation over the scale of connected ecosystems and there are several rationales for coordination at the scale of the Northwest Atlantic Ocean. The Northwest Atlantic is a relatively data-rich region, and this programme will help to develop programmes in other regional seas in the ICES area.
Resource requirements	Components of the integrated approach, such as ocean observation systems and ecosystem surveys, are being maintained by member countries, and the programme will coordinate and synthesize existing programmes.
Participants	The Group will be attended by some 20–25 members and guests.
Secretariat facilities	Report preparation and dissemination
Financial	No financial implications.
Linkages to advisory committees	During the development stage, there will be no direct linkages with advisory committees, but the integrated approach is expected to eventually support advice on Northwest Atlantic resources (e.g., NWWG).
Linkages to other committees or groups	There is a close working relationship with a number of the working groups under the Steering Group on Regional Seas and others within ICES. There is also a linkage to the ICES-GOOS Steering Group and Transition Group for the the development of ecosystem surveys in the Steering Group on Ecosystem Surveys and Sampling Technology.
Linkages to other organizations	The NAFO Ecosystem Based Mangement Working Group has made progress toward similar objectives and will be a resource for collaboration. The USA CAMEO program will fund projects in the region aimed at improving tools for ecosystem-based management and an international framework for implementation.

Additional Background

1. Introduction:

The Northwest Atlantic territorial seas are completely within the jurisdiction and influence of ICES member countries. Fisheries in this region are managed by individual member countries or through NAFO. Nevertheless, many ICES member nations are deeply involved in research in this region. The involvement of Canada and the USA is obvious, but other countries also have research needs: Greenland/Denmark, with extensive Arctic coastlines in the Northwest Atlantic; Spain and Portugal, with fleets that fish the international waters of the nose and tail of the Grand Banks and the Flemish Cap; etc.

The purpose of this programme is to form a Regional Sea Programme for coordinating marine science in the Northwest Atlantic, particularly ocean observation systems and ecosystem surveys to provide the infrastructure for an integrated approach to ecosystem science and management. There are four reasons to coordinate this programme wihtin the ICES Regional Sea Programme: 1) Ocean observations and ecosystem surveys in the Northwest Atlantic need to be better coordinated to support an integrated approach; 2) The Regional Sea Programme needs to be international. The participating countries are members of ICES and planning of the Regional Sea Programme can be done through an approved international activities conducted by ICES; 3) The coupling of ocean observing and ecosystem surveys in support of integrated science and management supports the priorities of the ICES Science Plan; and 4) ICES is an open scientific community which is necessary for the development of coordinated activities. ICES gives the effort the visibility to attract interested parties and provides the structure and outlets for the dissemination of results.

The U.S., Canada and NAFO have been involved in a variety of joint activities that have contributed to the development of an intergrated approach to marine science and managment. Recently, there has been a joint Habitat Working Group, involvement of U.S scientists in the Maritimes Ecosystem Research Initiative, and agreement to produce a joint Gulf of Maine Ecosystem Overview Report. These ecosystem-level activities have occurred against the backdrop of the work of the Transboundary Resources Assessment Committee (TRAC), which since 1998 has reviewed stock assessments and projections necessary to support management activities for shared resources across the U.S.-Canada border in the Gulf of Maine-Georges Bank region. Through these collaborations and interactions, there has been a general recognition that ocean observing activities should be better coordinated between the U.S. and Canada, especially in the Gulf of Maine-Georges Bank region.

The 2008 Annual Meeting of NAFO focused on the ecosystem aspects of the Northwest Atlantic, the establishment of fisheries management measures and improved monitoring and compliance. NAFO devoted considerable time to develop strategies of implementing an ecosystem approach to fisheries management. During a number of meetings NAFO addressed the identification of vulnerable marine ecosystems (VMEs) in the Northwest Atlantic and adopted necessary management measures to protect sensitive habitats including determination of the NAFO fishing "footprint", requirement to stop fishing upon encounter of a VME and exploratory fishery protocols for "new" fishing areas.

NOAA's Integrated Ocean Observing System supports two Regional Associations in the Northeast U.S. Continental Shelf ecosystem: the Mid-Atlantic Coastal Ocean Observing Regional Association (MaCOORA) and Northeastern Regional Association of Coastal Ocean Observing Systems (NERACOOS). MaCOORA covers the area from Cape Hatteras to southern Cape Cod. NERACOOS covers the area from the Hudson Canyon to the western Scotian Shelf. The Northeast U.S. Continental Shelf Ecosystem extends from Cape Hatteras to the western Scotian Shelf. For these Regional Associations to maximize their contribution to EAFM, their activities need to be coordinated. In addition, to support EAFM in the Northwest Atlantic Ocean, the observations of the U.S. Regional Associations need to be integrated with observations of Canadian counterparts (e.g., Canada-Newfoundland Operational Oceanography Forecast System; C-NOOFS).

In September 2008, the NOAA Northeast Fisheries Science Center established an Ecosystem Assessment Program, which is composed of scientists from a broad range of disciplines. The objective of this group is to understand and quantify natural and anthropogenic factors affecting production and resilience of marine ecosystems and the implications for human communities dependent on these systems. This group will develop Integrated Ecosystem Assessments for the northeast U.S. shelf ecosystem in support Ecosystem Approaches to Fishery Management (EBFM) and Ecosystem Appraches to Management. These products will require sustained ecosystem observations, conducted by a range of organizations and integrated into useable information. Stakeholders in the region are also interested in the development of an integrated approach to science and management. For examples, the New England Fishery Management Council organized a workshop to develop a policy document on EBFM in August 2009, and several coastal states in New England are in the developmental process of ocean plannig.

In October 2008, the idea of a Consortium was discussed at the World Summit on Ocean Observing Systems during an open meeting. The scientific community, as represented at this meeting, was interested in the idea and list of potential participants in future development of a consortium was generated. In March 2009, the ICES-GOES Steering Group met and noted the lack of coordination of observing activities on the western side of the Atlantic. NOAA and Canada DFO personnel discussed ways to remedy this situation and the idea of the ICES Study Group was developed.

2. Examples of potential projects:

2.1 Impacts of climate induced changes in the Labrador Current on fish community structure and production in the NW Atlantic – Climate change is affecting ecosystems worldwide, including the continental shelves of the Northwest Atlantic Ocean. The phenology of primary and secondary production will change. The distribution and abundance of resource species will change. The resilience and diversity of ecosystems will change. Since the shelves of the Northwest Atlantic Ocean are connected and climate change is a large-scale forcing, the consequences on the shelf ecosystems will be linked. To document and understand these consequences, observations are required across this region. The continental shelf of northeastern North America is connected by the Labrador Current, which originates on the Labrador Shelf and extends to Cape Hatteras, where it meets the northeastward flowing Gulf Stream. This current transports water, nutrients, and plankton through the entire region, resulting in a large-scale cohesion of the underlying oceanography. Global warming and subsequent ice melt in the Arctic is expected to increase cold freshwater input to the Labrador Current. It is hypothesised that this will a large area of water in the Northwest Atlantic and strengthen the stratification thus prevent nutrients from reach surface waters. Both of these factors could have

profound influence on fish and invertebrate populations in the Northwest Atlantic. Species of interest could include Atlantic cod, Greenland halibut northern shrimp, Atlantic salmon off W Greenland, American and European eel, snow crab, American plaice.

2.2 Temporal changes in the fish community of the NW Atlantic (Labrador to Cape Hatteras) - The large expanse of continental shelf in the Northwest Atlantic is connected by the biogeography of constituent species: from plankton, to benthic invertebrates, to finfish, to marine mammals, to sea turtles and sea birds. A number of species also make large-scale seasonal migrations across this region, connecting populations among local areas. Combining fisheries survey datasets throughout the region would support community analysis for detection of ecological changes. Analyses could include characterisation of assemblages and their changes, changes in species dominance, distributional shifts and their potential causes, including climate change and fishing effects.

2.3 Identification and conservation of sensitive habitats - Spatial analysis of continental shelf habitats from multiple sources could support the delineation of sensitive habitats for place-based management and ocean zoning. Critical habitat for marine ecosystem structure and function can be identified. Analysis of coordinated data can be used to evaluate habitat using existing data and also for gap analysis to guide more comprehensive evaluation of habitat.

Establishment of a new ICES Northwest Atlantic Regional Sea Programme (WGNARS)

There are many ocean observing activities underway including state, provincial and federal governments, various academic and private institutions, and numerous industry partners. To support integrated approaches, these smaller-scale activities need to be integrated; their requirements and allocation of resources need to be coordinated; their data formats compatible; there needs to be communication and exchange of information. To achieve these needs, a Regional Sea Programme for ocean observing across the Northwest Atlantic Ocean is proposed, which would include, but not be limited to, the Regional IOOS Associations (MaCOORA and NERACOOS), various Canadian Integrated Ocean Observing Systems including C-NOOFS, state and provincial activities, and NOAA and DFO observing programs.

The Northwest Atlantic Regional Sea Programme would serve many stakeholders but a primary goal would be to support EAFM and EAM in the region and in particular support DFO's and NOAA's responsibilities in the region. However, ocean observations would also be made and coordinated to meet the needs of other intergovernmental, federal, state and provincial management agencies. The Regional Sea Programme could directly support several of the NOAA Ecosystem Observation Program goals including i) provide the best available science to support the conservation and sustainable management of living marine resources; ii) develop and implement a program for the long-term collection, assimilation, and analysis of scientific data designed to measure the environmental quality of the nation's coastal ecosystems and to protect and enhance the coastal zone, iii) develop a strategy for integration and possible convergence of existing and future requisite coastal observing systems of the IOOS and iv) support ecosystem-based approaches to management by providing the best available science on the ecosystem components and processes that affect and interact with living marine resources. These achieve these goals in the Northwest Atlantic, existing ocean observing activities need to be coordinated across the region, which would also provide a regional platform for designing and implementing future observing activities.

2009/2/SSGRSP04 The **Workshop on Anchovy, Sardine and Climate Variability in the North Sea and Adjacent Areas** (WKANSARNS), chaired by Mark Dickey-Collas*, The Netherlands; Pierre Petitgas*, France; and Jürgen Alheit*, Germany, will meet in Nantes, France, 22–25 June 2010 to:

a) Synthesise and test the potential hypotheses for the multi-decadal fluctuations of anchovy and sardine abundance in the North Sea and adjacent areas;

b) Produce a working paper to be submitted for publication on the current understanding of the causes of the fluctuations of abundance relating to the hypotheses raised in a);

c) Recommend areas which required further investigation and highlight the gaps in our knowledge of the dynamics of anchovy and sardine in the North Sea for the purpose of stimulating and advising further research.

WKANSARNS will report by 15 August 2010 (via SSGRSP) for the attention of SCICOM.

Priority	The workshop is considered timely as it will bring together the various projects on small pelagics in the North Sea which have been ongoing. This is seen as a medium priority.
Scientific justification	The workshop fits into the first two thematic areas of the ICES Science plan in that it improves our understanding of the functioning of the North Sea ecosystem and also the interactions of humans with the ecosystem. There are many ongoing projects investigating the dynamics of North Sea anchovy and sardine, but these are as yet not feeding through into the ICES knowledge base. The purpose of this workshop is to aid these investigations by allow a cross fertilisation of ideas between researchers and to produce a working paper (aimed to be published in the peer reviewed literature) on the current state of our understanding of the dynamics of anchovy and sardine in the North Sea and the highlight challenges still remaining. The results will feed into the ICES position paper on climate change being prepared by the SGCC.
Resource requirements	No specific resource requirements beyond the need for members to prepare for and participate in the meeting.
Participants	These would include climatologists, oceanographers, ecologists, ecophysiologists, stock assessment scientists, ecosystem modellers.
Secretariat facilities	SharePoint site, secretarial support for the report.
Financial	None from ICES other than the report.
Linkages to advisory committees	An obvious very close link with the ICES Climate Change steering committee and the PICES FUTURE Scientific Steering Committee.
Linkages to other committees or groups	This area of research has many links to both ACOM and SCICOM expert groups.
Linkages to other organizations	ICES and PICES will seek widened participation for this group including contact with relevant academic and intergovernmental.

2009/2/SSGRSP07 The **Working Group on Large Marine Ecosystem Programme Best Practices** (WGLMEBP), chaired by Mick O'Toole, Ireland, and Jan Thulin, ICES, will be established and will meet at ICES HQ, Copenhagen, 23–24 March 2010 to:

a) To identify best practices in the selection of science-based indicators for adaptive ecosystem-based management within the framework of the Large Marine Ecosystem (LME) projects;

b) To evaluate and compare among LMEs the prescribed principal indicators used to index conditions in relation to resource recovery, climate change, and sustaining socioeconomic benefits;

c) To report findings and methods of best practice in Community of Practice handbooks, publications and reports, including those of the WG-LME-BP. These will be made available to LME practitioners, the public and other interested parties in the developing and developed world;

d) To develop effective training modules consistent with effective implemention of best practices for ecosystem-based management at the LME scale;

e) Draw up terms of reference that relate to a work plan for the next three years, that complement the ICES science plan.

WGLMEBP will report by 1 May 2010 (via SSGRSP) for the attention of SCICOM and ACOM.

Supporting information

Priority	Investments in LME programs in the developing and developed world require implementation plans that are effective and efficient. A critical review of LME principles and implementation success will lead to more effective LME programs resulting in measurable progress in ststaining marine and coastal ecosystems.
Scientific justification	What is presently lacking is a process to identify, review, and synthesize the best assessment and management practices among the community of LME practitioners facilitating the exchange of lessons learned. To date, no effort has been made to analyze and integrate the scientific findings from these projects and to disseminate them to regional and global partners. Additionally, there has been little opportunity to inform LME project scientists and managers about broader global ocean issues, emerging challenges, new methodologies and science and policy breakthroughs in shaping ecosystem-based management. A cross-system comparative analysis would be useful in strengthening the scientific capacity of countries for adaptive ecosystem-based management. The LME projects have reached a level of experience and practice where it is beneficial and cost effective to share experiences, information, technological improvements, measurable benefits, and effective practices and lessons, and direct the information to all project participants. It is critical to provide adaptive management stategies that reflect changing circumstances, in view of the accelerating effects of climate change on marine ecosystems. It is especially important during this economic downturn to maximize available and pertinent LME information in a cost effective way. Given the emphasis on science supporting EBM in the ICES Science Plan, using the past and present LME program outcomes to inform future national and international programs is prudent.
Resource requirements	The LME programs being reviewed by this Working Group are already underway and information necessary for the Working Group to function has already been made available. It is envisioned that LME practioners and selected independent scientists will assist conducting a critical review of best practices in science and governance of LMEs.
Participants	The Group will be attended by some 20–25 members and invited scientists.
Secretariat facilities	Meeting room, report preparation and dissemination.
Financial	No financial implications.
Linkages to advisory committees	There are no obvious direct linkages with the Advisory Committee.
Linkages to other committees or groups	There is a very close working relationship with a number of the working groups under the SCICOM Steering Group on Regional Seas and others
Linkages to other organizations	The establishment of this Working Group will inform and is endorsed by the Intergovernmental Oceanographic Commission (IOC), Food and Agricultural Organization (FAO), the United Nationa Environment Program (UNEP), and the Global Environmental Facility (GEF).

Additional Background

1. Introduction

Overfishing, marine pollution, habitat loss and climate change are contributing to the degradation in the world's marine ecosystems. The net economic benefits provided by coastal oceans are declining even as the coasts become more populated and large segments of the population more dependent on coastal fisheries as their main source of protein. Prompt and

large scale changes in the use of ocean resources are needed to overcome the negative consequences of human exploitation.

Beginning in 1995, the Global Environment Facility (GEF) has been providing financial support to developing countries committed to the recovery and sustainability of large marine ecosystems (LMEs) off their coasts. A useful tool in the GEFs arsenal has been a modular indicator-based approach to the assessment and management of LMEs. The comprehensive approach to GEF-funded LME projects has focused on measures of changes in LMEs for (i) productivity, (ii) fish and fisheries, (iii) pollution and ecosystem conditition, (iv) socioeconomics, all enabled through (v) governance. Ecosystem measurements for the first three provide a basis for scientific input into policy and management discussions leading to socioeconomic benefits and mutually agreeable and hopefully effective marine governance regimes. The GEF has provided support for ecosystem projects in one hundred and ten countries (more than half the countries of the globe) in Africa, Asia, Latin America and Eastern Europe to identify root causes of marine ecosystem deterioration and provide guidance for recovery should best management practices be implemented. LME projects in the Benguela Current, Yellow Sea, Guinea Current, Baltic Sea and Agulhas and Somali Currents, are joint initiatives funded by the GEF, the World Bank, and the governments of the participating countries adjacent to the LME. The results of the LME programs in these areas are working toward the management and utilization of the LME resources in a sustainable and integrated manner. The applied and pragmatic LME approach uses 1) science based assessments of LME productivity, fish and fisheries, pollution and ecosystem condition, and (2) linking the science based assessments of the changing states of LMEs to management actions for recovering depleted fisheries, restoring critical habitats assesses and managing large ocean areas for sustained biological productivity.

2. Issue to be addressed

What is presently lacking is a process to identify, review, and synthesize the best assessment and management practices among the community of LME practitioners facilitating the exchange of lessons learned. To date, no effort has been made to analyze and integrate the scientific findings from these projects and to disseminate them to regional and global partners. Additionally, there has been little opportunity to inform LME project scientists and managers about broader global ocean issues, emerging challenges, new methodologies and science and policy breakthroughs in shaping ecosystem-based management. A cross-system comparative analysis would be useful in strengthening the scientific capacity of countries for adaptive ecosystem-based management. The LME projects have reached a level of experience and practice where it is beneficial and cost effective to share experiences, information, technological improvements, measurable benefits, and effective practices and lessons, and direct the information to all project participants. It is critical to provide adaptive management stategies that reflect changing circumstances, in view of the accelerating effects of climate change on marine ecosystems. It is especially important during this economic downturn to maximize available and pertinent LME information in a cost effective way. Given the emphasis on science supporting EBM in the ICES Science Plan, using the past and present LME program outcomes to inform future national and international programs is prudent.

Establishment of a new ICES Large Marine Ecosystem Community of Practice Working Group (WG-LME).

The objective of the working group would be the sharing of information (e.g., data, lessons learned and best managment practices) developed through the LME project process among the the global marine science community.

ICES has a long and successful history in the coordination and promotion of marine research in oceanography, the marine environment, marine ecosystems, and living marine resources in the North Atlantic. This Working Group would utilize the extensive ICES scientific network to gather additional information about marine ecosystems, filling gaps in existing knowledge and providing information and unbiased, non-political advice as it related to LMEs around the world. Given the global nature of the GEF-funded LME work, it may be possible for ICES to

enlist other international marine science organizations such as PICES and IOC in a joint working group setting, and this should be explored.

2009/2/SSGRSP06 The **ICES/ESSAS Workshop on Ecosystem Studies of Sub-Arctic Seas** (ICESSAS), chaired by George Hunt*, USA, and Ken Drinkwater*, Norway, will meet in Reykjavik, Iceland, 30 August – 1 September 2010 to:

a) Present recently completed ESSAS research carried out in the Barents Sea and the Oyashio System off Japan, as well as comparative studies between Norwegian, US and Canadian ecosystems;

b) Examine the ecosystem structure and function in, and determine the connectivity between, Icelandic, Greenland and Labrador Sea waters;

c) Determine the interactions between invertebrate and gadoid populations through comparative analysis between several sub-arctic seas in both the Atlantic and Pacific regions;

d) Extend modelling efforts to develop an end-to-end ecosystem model with special emphasis on the inclusion of fish populations.

The workshop will complete its Terms of Reference by a series of topical sessions a) to d). ESSAS will provide an oral report to SSGRSP at the 2010 ASC and a written report one month later.

ICESSAS will report by 15 October 2010 (via SSGRSP) for the attention of SCICOM.

Supporting information

Priority	ESSAS is a Regional Program of GLOBEC and IMBER whose main goal is to compare, quantify and predict the impact of climate variability and global change on the productivity and sustainability of Sub-Arctic marine ecosystems. The geographic focus is the northern regions of the Atlantic and Pacific Oceans. ESSAS holds an annual workshop during which a series of topical session proposed by ESSAS's Working Groups are held. The ESSAS Workshop in 2010 is critical for the WG on gadoid-invertebrate interactions to carry out their comparisons between different sub-Arctic ecosystems as a means of testing the hypothesis that the disappearance (rise) in gadoids lead to an increase (decrease) in invertebrates. Also, the ESSAS WG on Modelling is presently involved in the development of an end-to-end model and this workshop will continue this work. Also studies have been carried out within ESSAS in Icelandic waters and the Labrador Sea. We wish to extent our studies into West Greenland, and to compare the three regions as well as examine their connectivity.
Scientific justification	Term of Reference a): Leaders-G. Hunt (USA), K. Drinkwater (Norway), Y. Sakurai (Japan) Several ESSAS projects have been completed during the past year or two. A synthesis of these projects will be presented and will be used as a means to determine where the gaps in our knowledge are, particularly in regards to physical forcing of the ecology in sub-Arctic seas. Term of Reference b): Leaders-O. Palsson (Iceland), K. Wieland (Denmark), E. Head (Canada) Large changes have occurred in the waters around Iceland, Greenland and in the Labrador Sea. A 1-day session will be held to compare and contrast the different regions in terms of their physical and biology components. In addition, the physical and biological connectivity between the different regions will be examined, where possible. Term of Reference c): Leaders-F. Mueter (USA) and E. Dawe (Canada) One of the ESSAS Working Groups has begun to consider the interaction

	between gadoids and invertebrates. Last year a topical session was held to describe what relevant physical and biological data were avaiable for 8 different sub-Arctic (Oyashio, Bering Sea, Gulf of Alaska, Newfoundland, Labrador, West Greenland, Iceland, Barents Sea) in the Atlantic and Pacific Oceans and to determine the types of analyses that should be carried out in each area. A half day session this year will provide the oppourtunity to present the results of thes analyses and begin the comparisons between these seas. Term of Reference d): Leaders-B. Megrey (USA), K. Rose (USA), S.I. Ito (Japan) Development of an end-to-end model based on ROMS modelling has been underway for the past year and a half. Last year some of the technical considerations were proposed and discussed. This session will allow further discussion and input from the biological community on the model, especially the inclusion of fish populations.
Resource requirements	The research programmes and activities that provide the main input to this group are already underway, while resources are already committed or are being requested from national funding agencies and IMBER. We request support from ICES in terms of endorsement and encouragement of ICES members to send their scientists.
Participants	The Group is normally attended by some 25–50 members and guests.
Secretariat facilities	None
Financial	No financial implications.
Linkages to advisory committees	There are no obvious direct linkages with the ICES Advisory Committee.
Linkages to other committees or groups	ESSAS is linked to the Regional Sea Programmes Steering Committee (SSGRSP). It is also very relevant to the Ecosystem Function Steering Committee (SSGEF) and many EGs within that committee as well as the WGFCCIFS .
Linkages to other organizations	ESSAS is part of IMBER and GLOBEC and has close associations with PICES and the North Pacific Research Board (including the BESTand BSIERP projects), IPY organization.

SSGHIE Terms of Reference 2009

2009/2/SSGHIE07 The **Working Group on Marine Shellfish Culture** (WGMASC), chaired by Pauline Kamermans, the Netherlands, will meet in Galway, Ireland together with WGEIM, 29 March–2 April 2010 to:

a) Identify emerging shellfish aquaculture issues and related science advisory needs for maintaining the sustainability of living marine resources and the protection of the marine environment. The task is to briefly highlight new and important issues that may require additional attention by the WGMASC and/or another Expert Group as opposed to providing a comprehensive analysis;

b) Review the state of the knowledge of site selection criteria in molluscan aquaculture with particular reference to accessing and developing offshore facilities.

c) Review knowledge and report on the significance to wild stocks of bivalve aquaculture transfers between sites/countries. This will include information on what species are transported where, what records are kept, and

what guidelines are in place in ICES countries related to the transfer of cultured species.

d) Review and assess: the potential for transfer of non-indigenous species and diseases; the potential genetic implications for wild stocks; the impact on recruitment to existing stocks by large-scale transfers, and scientific tools for decision support on cultured shellfish transfer issues; and

e) Review the state of knowledge of the evidence for and effect of climate change on shellfish aquaculture distribution and production in ICES and countries worldwide.

f) Report to SSGHIE on potential and current contributions of your EG to the Strategic Initiative on Coastal and Marine Spatial Planning (SICMSP).

g) Report to SSGHIE on your plans to promote cooperation between EGs covering similar scientific issues.

WGMASC will report by 1 May 2010 (via SSGHIE) for the attention of the SCICOM.

Supporting Information

Priority	WGMASC is of fundametal importance to ICES environmental science and advisory process and addresses many specific issues of the ICES Strategic Plan and the Science Plan. The current activities of this Group will lead ICES into issues related to the ecosystem effects of the continued rapid development of shellfish aquaculture, especially with regard to the implications of changing environmental conditions on shellfish cultures Consequently, these activities are considered to have a high priority.
Scientific justification	**Term of Reference a)** For the WGMASC to be responsive to the rapidly changing science advice needs of aquaculture and environmental managers, important emerging shellfish aquaculture issues need to be rapidly identified and screened for potential science advisory needs to maintain the sustainable use of living marine resources and the protection of the marine environment. The intention is for this activity to flag issues that may require future attention and communication between one or several ICES Expert Groups. The Chair of the WGMASC will cross-reference all work with SCICOM and relevant Working Groups. **Term of Reference b)** Spatial competition for aquaculture sites along coastal seas has encouraged the initiative of moving shellfish aquaculture into the open ocean at exposed sites within the EEZ. These offshore sites require an understanding of the adaptive capabilities and limitations in growth potential for species at these sites, the development of new technologies capable of withstanding these high energy environments and the necessary institutional arrangements (e.g. marine spatial planning). It is also essential in site selection to consider biotic and abiotic factors in association with economic, ecological and socio-economic perspectives, whether in the coastal zone or at offshore locations. Beside basic investigations on these parameters conditions of a preferred site can be investigated by analysing the overall health status of shellfish grown in different areas (e.g. blue mussels) as a bio-indicator of site suitability. This ToR aims to: assess site selection criteria in ICES countries; provide an overview of current research and commercial operation on offshore shellfish farming, both for spat collection or for ongrowing to market size. In addition, it is intended to investigate the sustainable use of oceans by integrating aquaculture and fisheries and assess the potential for combining shellfish culture with other offshore constructions such as renewable energy facilities or any other. The Chair of WGMASC will cross-reference all work with SCICOM and relevant Working Groups. **Term of Reference c) and d)**

	Different shellfish life stages are transported from hatcheries and field sites to new culture sites, and often cross international boundaries, with potential implications for the introduction of non-indigenous species and diseases and the potential for interactions with wild stocks (impact on recruitment, genetic composition, diversity and polymorphism, and physiological and morphological traits). There is a need to identify the significance of shellfish relocations on the geographic distribution of wild stock traits. The significance to wild stocks of such transfers requires information on what species are transported where, what records are kept, and what guidelines are in place in ICES countries related to the transfer of cultured species. Scientific tools for decision support on cultured shellfish transfer issues should be reviewed and assessed. The Chair of WGMASC will cross-reference all work with the Chairs of the WGEIM, WGPDMO and WGITMO. **Term of Reference e)** Climate variability affects the recruitment and production of important commercial species and affects site suitability for shellfish culture. Increased knowledge of the effects of climate change on shellfish culture is needed to predict and assess impacts on aquaculture distribution and production. The Chair of WGMASC will cross-reference all work with the Chair of the WGEIM. **Term of Reference f)** This strategic initiative is currently being planned and suggestions from EGs on their engagement in the SICMSP are sought. **Term of Reference g)** Collaboration across EGs is encouraged and may be facilitated by e.g. inviting EG chairs and/or key members to attend meetings of your EG, and to use teleconferencing and videoconferencing as means to engage participants remotely **.**
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.
Participants	The Group is normally attended by some 10–12 members and guests.
Secretariat facilities	None.
Financial:	No financial implications.
Linkages to advisory committees	SCICOM
Linkages to other committees or groups	There is a working relationship with the WGEIM, WGIMTO, WGPDMO, and the work is relavant to WGICZM.
Linkages to other organizations:	The work of this group is aligned with similar work in GESAMP, WAS, and EAS and numerous scientific and regulatory governmental departments in ICES countries.

2009/2/SSGHIE08 The **Working Group on Environmental Interactions of Mariculture** (WGEIM), chaired by Chris McKindsey, Canada, will meet in Galway, Ireland, 29 March–2 April 2010 to:

a) evaluate the examples of sustainability indices proposed for mariculture activities and critically evaluate those SI's recommended by WGEIM and other fora;

b) investigate and report on fouling hazards associated with the physical structures used in mariculture with a view to developing integrated pest management strategies;

c) review the outputs of a number of integrated aquaculture (multi-trophic culture systems) projects and address the issue of energy and nutrient cycling associated with IMTA systems and report in 2009;

d) review and report on the use of seed stock quality criteria in mariculture and their applications in term of ecological performance;

e) assess the potential impact of climate change on aquaculture activities relevant to each ICES member state;

f) provide an update on fin fish feed usage and constituents from member countries to included in the meeting report in 2009.

g) Effects of mariculture on populations of wild fish (OSPAR request 2010/3). While there is general agreement on the range of potential forms of interaction between farmed and wild stocks, there is much less agreement on the current and future significance of these interactions for wild stocks. OSPAR ask ICES:

- To provide advice on the current state of knowledge on the interaction of finfish mariculture on the condition and wild fish populations (both salmonid and non-salmonid) both at a local and regional scale, including from parasites, escaped fish and the use of fish feed in mariculture. Advice is requested on how the interactions will change as a result of an expansion of mariculture activities.
- OSPAR suggest that this should be addressed through a risk analysis approach, making best use of both quantitative and qualitative methodologies, and that an important aspect of the outcome will be clear identification of the specific aspects of the risk analysis where additional research effort may best be targeted to reduce the uncertainty in the risk analysis.
- This work should be coordinated between WGEIM and WGAGFM through communication between the chairs and correspondence.

h) Report to SSGHIE on potential and current contributions of your EG to the Strategic Initiative on Coastal and Marine Spatial Planning (SICMSP).

i) Report to SSGHIE on your plans to promote cooperation between EGs covering similar scientific issues.

WGEIM will report by 30 April 2010 for the OSPAR Advice and by 15 May 2010 (via SSGHIE) for the attention of SCICOM and ACOM.

Supporting Information

Priority	The activities of this group are fundamental to the work of the Mariculture Committee. The work is essential to the development and understanding of the effects of man-induced variability and change in relation to the health of the ecosystem. The work of this ICES WG is deemed high priority.
Scientific justification	**ToR a)** The group agreed to progress the work on sustainability indices by conducting intercessional work on developing practical indices for finfish aquaculture. This will be achieved by examining data from existing monitoring programmes in member countries. Lead: Ian Davies, Scotland. **ToR b)** Structure associated with mariculture activities can provide considerable surface area for colonisation of species not typically found

in the culture area. This is presumably due to the increased habitat complexity and appropriate substrate for epifuanal organisms. In addition to the potential to provide a pathway for the introduction of an exotic nuisance species to a system, additional problems encountered are those associated with the management of the uisance to reduce the impact on the culture acitivity. This ToR will highlight existing examples and will address the management implications and potential mitigation strategies by examinaning a range of case studies from Canada and Spain specifcially. Lead: Chris McKindsey, Canada.

ToR c) Evaluation of the outputs of a number of integrated aquaculture (multi-trophic culture systems) projects has been covered by WGEIM for the last number of years and will continue to be evaluated by the group. In addition, the output of nutrients in IMTA or production systems in general, may lead to increased productivity or anoxic systems with consequences at both ends of the spectrum (water column and benthos). In bivalve culture, planktonic communities may be altered directly through grazing with respect to flushing and differential reproduction of plankton communities (e.g. compare copepod reproduction to heterotrophs). Various nutrient fluxes (from bivalves and structures as well as benthos) may impact water column nutrient dynamics and thus the whole pelagic ecosystem. This ToR will examine the fate of energy and nutrients form aquaculture systems and discuss the consequences for the environment and IMTA systems in general. Lead: Stephen Cross and Shawn Robinson, Canada.

ToR d) For economical reasons, mariculture development is based on the continuous improvement of seed and fry, being wild or produced in hatcheries. How these improvements, particularly those which contribute to increase the physiological fitness and food efficiency may impact the use of the resources from the natural environment is a question of high relevance for decision making. The trade off between the economical and the ecological performance of mariculture, and consequently the regulations (e.g. licensing) to follow, is consistent with the objectives of sustainability and responsible natural resources management. The aim of this work will be to review the use of seed stock quality criteria in mariculture and their applications in term of ecological performance. Lead: Thomas Landry, Canada.

ToR e) Predicting the impact of climate change on marine systems has become an important and topical exercise for numerous authorities in recent years. Numerous predictions relating to sea level rise and water temperature changes have sparked considerable speculation on the potential to influence the distribution of marine species. Aquaculture species, particularly those found on the boundaries of climatic regions, may be at risk of greatest impact due to climate change. The geographical distribution of some highly productive and important aquaculture processes and species could expand as a consequence of a rise in sea temperatures (e.g. range expansion of reproducing populations of Crassostrea gigas to more northerly parts of Europe). Other issues that might be covered are the influene changing climate might have on the prevalence of disease causing organims, the potential to culture new species, influence on harmful algal blooms, the impact of increased run-off might have on shellfish waters classification and the impacts of increased storminess might have on mariculture activities. Lead: no lead assigned yet.

ToR f) WGEIM and other ICES group have previously reviewed the issue on fin fish feed usage and constituents from member countries. However, the sustainability of utilising fish based feed products for marine fish farm activities continue to be questioned and justification continues to be sought. Feed producing companies are apparently endeavouring to find alternative sources. The goal of this work package is to provide an update within each member country of the proportion

	and constituents of alternative feeds used in finfish aquaculture. Lead: no lead assigned yet. **ToR g)** This is an OSPAR Request (2010/3). The scale of cultivation of both fish and shellfish species in coastal waters of the OSPAR area continues to increase. In some countries, the value of aquaculture products exceeds that from wild capture fisheries. Aquaculture is currently concentrated in coastal waters. taking advantage of the sheltered conditions available there, and also in response to other practical economic and engineering factors, such as accessibility for operators and to downstream processing facilities, and the difficulty and cost of maintaining structures in open water offshore areas. Some of the environmental interactions of coastal aquaculture operate on very local scales. These include enrichment of the seabed by waste feed and faeces, or the potential toxic effects of used chemicals such as medicines and antifoulants. These generally can be regulated through local licensing and consenting systems. However, other forms of environmental interactions have the potential to have influence over rather larger areas. A number of these concern wild fish populations. Examples include the pressure on wild stocks to provide raw materials (fish protein and lipid) for pelleted diets for farmed fish, interbreeding of escaped farmed fish with wild stocks reducing their fitness, and the more direct stress arising from the possible transfer of parasites of farmed to wild stocks (notably sea lice from farmed salmon to wild salmon and sea trout) and consequent impacts on wild populations. **ToR h)** This strategic initiative is currently being planned and suggestions from EGs on their engagement in the SICMSP are sought. **ToR i)** Collaboration across EGs is encouraged and may be facilitated by e.g. inviting EG chairs and/or key members to attend meetings of your EG, and to use teleconferencing and videoconferencing as means to engage participants remotely.
Resource Requirements	None
Participants	The Group is normally attended by some 12–15 members and guests
Secretariat Facilities	None
Financial	No financial implications
Linkages to Advisory Committees	ACOM
Linkages to other committees or groups	WGEIM interacts with WGMASC, WGAGFM, MARC
Linkages to other organisations	The work of this group is undertaken in close collaboration with the DFO Gesamp group, BEQUALM, OIE, EU, EAS, PICES

2009/2/SSGHIE09 The **ICES - IOC Working Group on Harmful Algal Bloom Dynamics** (WGHABD), chaired by Joe Silke, Ireland, will meet in Bermuda, UK, 6–10 April 2010 to:

a) Assess national reports submitted to HAEDAT and review;

b) Collate and submit on-line National reports no later than 1 February 2010 national reports 2002–2009 for HAEDAT, review at working group;

c) Review and assess the information compiled in the updated ICES-IOC data base on HAB monitoring systems, MONDAT;

d) Discuss and formulate the description and justification for a thematic session on HABs and Modelling for the 2010 ASC;

e) Review the draft chapters for the cooperative research report;

f) Present any relevant information from compilation of data for cooperative research report;

g) Review the strategies being used to identify, enumerate, and otherwise investigate the life history stages of HAB species, and the information obtained from such efforts;

h) Discuss new findings that pertain to harmful algal bloom dynamics. Bring new findings in phytoplankton population dynamics models to the attention of WGHABD for discussion;

i) Review WGHABD contribution to the ICES White Paper on Climate Change;

j) Report to SSGHIE on potential and current contributions of your EG to the Strategic Initiative on Coastal and Marine Spatial Planning (SICMSP).

k) Report to SSGHIE on your plans to promote cooperation between EGs covering similar scientific issues.

WGHABD will report by 11 May 2010 (via SSGHIE) for the attention of SCICOM.

Supporting information

Priority	The activities of this group are fundamental to the work of the Oceanography Committee. The work is essential to the development and understanding of the effects of climate and man-induced variability and change in relation to the health of the ecosystem. The work of this ICES-/IOC WG is deemed high priority.
Scientific justification	**Term of Reference a)** National Presentations and review occurrences of HABs in the ICES area, making use of the HADAT system. **Term of Reference b)** The HAEDAT system is due to be populated to catch up on lost years while it was undergoing database re-design. The working group will assess Status for upload of all records 2002–2009; Status of quality assurance of HAEDAT records prior to 2002; New decadal maps based on HAEDAT data **Term of Reference c)** The IOC MONDAT database contains valuable information on national HAB monitoring practices. The database will be reviewed and the paper based questionnaire which is used to gather the data examined for potential improvements. **Term of Reference d)** A thematic session on HABs and Modelling for the 2010 ASC has been proposed jointly with WGPBI . Details of the session will be discussed and information regarding participants / abstracts presented. Potential for future collaborations in this area stemming from this theme session will be explored. **Term of Reference e)** Assigned lead editors for the proposed cooperative research report on HABs in the ICES area chapters will present the outlines/ drafts of their work in progress for discussion at the Working group. Editorial and drafting session will be convened during the course of the working group meeting. **Term of Reference f)** Members of the working group are asked to collaborate and engage in the

	process of crafting the Cooperative Research Report on HABS in the ICES area. Where data is identified as being important and available, the working group will jointly assess the data and how to best prepare and summarise this in the report. Members with access to relevant data are encouraged to present data holdings. **Term of Reference g)** It is well established that life history stages are critically important in the population dynamics of many HAB species, particularly those that form cysts or other resting stages . Unfortunately, our ability to identify these stages or to enumerate them or study their specific dynamics or physiology are quite limited. New techniques are being developed to accomplish these objectives, and there is thus great value in reviewing the methods being used or developed, and to explore the extent to which these methods can be transferred to other workers, or applied to other HAB species. A realistic model of a phytoplankton population should take into account all the life stages encountered by this same population as well as transitions. As an example, rate of production of gametes and the duration of this stage are essential to estimate a realistic encounter rate. Likely, duration of the free-swimming phase for planozygotes will determine the dispersal of cysts (analogous to the "seed–shadow" for terrestrial plants). In order to produce realistic biological models, it is essential to validate in situ results from laboratory experiments. Methods to identify and quantify different stages of the life cycle of a given species are urgently needed in order to allow a proper validation of assumptions made in the elaboration of population dynamics models. **Term of Reference i)** WGHABD is a useful forum to discuss and present new findings amongst the members. This is an excellent forum to promote and discuss topics of relevance. There are obvious reasons to continue this topic as an ongoing term of reference **Term of Reference i)** The Science Strategic Initiative on Climate Change (SSICC) are in the process of drafting a white paper on Climate Change. WGHABD will work intersessionally to prepare a submission on Climate Change and HABs. This will be discussed at the working group and any last changes to the draft will be made and submitted to the SGCC. **Term of Reference j)** This strategic initiative is currently being planned and suggestions from EGs on their engagement in the SICMSP are sought. **Term of Reference k)** Collaboration across EGs is encouraged and may be facilitated by e.g. inviting EG chairs and/or key members to attend meetings of your EG, and to use teleconferencing and videoconferencing as means to engage participants remotely.
Resource Requirements	The research programmes which provide the main input to this group are already underway, and resources already committed. The additional resource required to undertake additional activities in the framework of this group is negligible.
Participants	The Group is normally attended by some 20–25 members and guests
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	WGHABD interacts with WGZE, WGPE, WGPBI.

groups	
Linkages to other organisations	The work of this group is undertaken in close collaboration with the IOC HAB Programme. IOC should be consulted regarding ToR or discontinuation of the WG prior to the ASC. There is a linkage to SCOR through the interactions of the IOC-SCOR GEOHAB Programme.

2009/2/SSGHIE11 The **Joint PICES/ICES Working Group on Forecasting Climate Change Impacts on Fish and Shellfish** (WGFCCIFS), chaired by Anne Hollowed, USA; Manuel Barange, UK; Suam Kim, Korea; and Harald Loeng, Norway, will meet in Sendai, Japan on 30 April 2010 (a day after the international symposium "Climate change effects on fish and fisheries") to:

a) Review the results of the conference in light of the terms of reference of the WGFCCIFS, in particular regarding:

i. frameworks and methodologies for forecasting the impacts of climate change on marine ecosystems, with particular emphasis on the distribution, abundance and production of commercial fish and shellfish;

ii. methodologies applied in designated case studies;

iii. techniques for estimating and communicating uncertainty in forecasts;

iv. strategies for research and management under climate change scenarios, given the limitations of our forecasts.

b) Continue promote research on climate change impacts on marine ecosystems by scientists in ICES and PICES member nations through coordinated communication, exchange of methodology, and organization of meetings to discuss and publish results;

c) Produce publications that are relevant to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change;

d) Publish report(s) summarizing work;

e) Report to SSGHIE on potential and current contributions of your EG to the Strategic Initiative on Coastal and Marine Spatial Planning (SICMSP).

f) Report to SSGHIE on your plans to promote cooperation between EGs covering similar scientific issues.

WGFCCIFS will report by 1 September 2010 (via SSGHIE) for the attention of SCICOM and SSICC, and by 1 October 2010 to the PICES FIS and POC Committees.

Supporting Information

Priority	The work of the WGFCCIFS is essential to ensure that ICES and PICES will be able to provide guidance on the potential impacts of climate change on marine ecosystems and the response of commercial fish and shellfish resources to these changes.
Scientific justification	The work done within ICES and PICES on Climate Change and fisheries has been diverse and has included: a) guidance on methods for selection of IPCC scenarios for use in projections; b)techniques for downscaling IPCC scenarios to local regions, c) development of coupled ecosystem models for use in evaluating climate induced shifts in environmental conditions, d) literature documenting relationships between climate forcing and marine fish and shellfish distribution and production, and e)

	stock assessment techniques for evaluating management strategies to mitigate the impacts of change. A challenge facing ICES and PICES is the need to integrate all of this research to provide stakeholders with quantitative estimates of the potential impact of climate change on marine life throughout the world. This challenge calls for the establishment of an interdisciplinary research team composed of experts from around the world who will focus attention on the development of common and standardized frameworks for forecasting climate change impacts on marine life with particular emphasis on commercially important fish and shellfish. ICES and PICES should act now to ensure that our research communities develop the capibilities to provide quantitative contributions to the next IPCC reports and to provide guidance for management under climate change scenarios. Several case studies will be identified by the Steering Group based on their potential for contributing to methodological development and the opportunity for comparison of marine species and community responses to climate forcing in different ecosystems. Members of the working group will be responsible for encouraging the development of regional interdisciplinary teams responsible for the production of forecasts. Members of the working group will provide guidance to the regional teams by providing a framework for the development of the forecasts and communication of new advances in analytical tools. A major contribution of the working group's effort will be presentation and discussion of results at a science symposium in 2010 and publication of results in a peer reviewed journal by 2011. The timing for the publication is critical because the future IPCC AR5 report is slated for release in 2013. (ToR e) This strategic initiative is currently being planned and suggestions from EGs on their engagement in the SICMSP are sought. (ToR f) Collaboration across EGs is encouraged and may be facilitated by e.g. inviting EG chairs and/or key members to attend meetings of your EG, and to use teleconferencing and videoconferencing as means to engage participants remotely **.**
Resource requirements	No specific resource requirements beyond the need for members to prepare for and participate in the meeting.
Participants	These would include climatologists, oceanographers, ecologists, stock assessment scientists, ecosystem modellers, fisheries managers and economists. Participation is sought from members of PICES and ICES as well as scientists from the southern hemisphere. Potential working group members: James Overland, USA (ESSAS, PICES POC), Shin-ichi Ito, Japan (ESSAS, PICES POC), Michael Foreman, Canada (PICES POC), Sang-Wook Yeh, Korea (PICES WG 20), Thomas Okey, Canada (PEW trust), Richard Beamish, Canada (NPAFC, PICES FIS), Daniel Duplisea, Canada (ICES), Jason Holt, United Kingdom (QUESTFISH, ICES), Keith Brander, Denmark (ICES, IPCC ecosystem writing team), Jürgen Alheit, Germany(ICES, GLOBEC SPACC), Ken Drinkwater, Norway (ESSAS; ICES)].
Secretariat facilities	This group is likely to have high demand on the computing resources of the Secretariat, but no additional software/hardware is anticipated beyond that which is currently available.
Financial	PICES invitational travel for 4 scientists.
Linkages to advisory committees	An obvious very close link with the ICES Climate Change steering committee and the PICES FUTURE Scientific Steering Committee.
Linkages to other committees or groups	Methodological issues are within the mandate of this Group but for the purpose of this meeting this issue is not on the agenda. Fish stock assessment methods for forecasting and conducting management strategy evaluations will be discussed, as will various eocsystem modelling approaches. Techniques for selecting and downscaling

	climate change scenarios for use in forecasts will also be discussed. Knowledge of the mechanisms underlying commercial and other species and community responses to shifts in oceanography will be critical to the formation of forecasts.
Linkages to other organizations	ICES and PICES will seek widened participation for this group including contact with relevant academic and intergovernmental organisations including fisheries managers and FAO for this meeting.

2009/2/SSGHIE12 The **Working Group on the Application of Genetics in Fisheries and Mariculture** (WGAGFM), chaired by G. Dahle, Norway, will meet in Cork, Ireland, 5–7 May 2010 to:

a) Report on how to utilise genomic approaches to the study of adaptation of marine organisms in changing environments: what can populations tell us about genes underlying phenotypic and demographic changes and what can genes tell us about adaptive evolution of populations?;

b) Define genetic data needs and explore opportunities and requirements for the integration of genetic data resulting from the implementation of the EU data collection regulation (DCR 199/2008);

c) Review the issues and challenges associated with the utilization of SNPs as markers in population genetic studies with special attention to data handling and statistical tools;

d) Pursuing the establishment of a meta-database cataloguing existing data in the field of fish and shellfish genetics;

e) Review the genetic effects of exploitation on deep-sea fish.

f) Effects of mariculture on populations of wild fish (OSPAR request 2010/3) While there is general agreement on the range of potential forms of interaction between farmed and wild stocks, there is much less agreement on the current and future significance of these interactions for wild stocks. OSPAR ask ICES:

- To provide advice on the current state of knowledge on the interaction of finfish mariculture on the condition and wild fish populations (both salmonid and non-salmonid) both at a local and regional scale, including from parasites, escaped fish and the use of fish feed in mariculture. Advice is requested on how the interactions will change as a result of an expansion of mariculture activities.
- OSPAR suggest that this should be addressed through a risk analysis approach, making best use of both quantitative and qualitative methodologies, and that an important aspect of the outcome will be clear identification of the specific aspects of the risk analysis where additional research effort may best be targeted to reduce the uncertainty in the risk analysis.
- This work should be coordinated between WGEIM and WGAGFM through communication between the chairs and correspondence.

g) Report to SSGHIE on potential and current contributions of your EG to the Strategic Initiative on Coastal and Marine Spatial Planning (SICMSP).

h) Report to SSGHIE on your plans to promote cooperation between EGs covering similar scientific issues.

WGAGFM will report by 12 May 2010 (via SSGHIE) for the attention of SCICOM and ACOM.

Supporting Information

Priority	The current activities of this Group will lead ICES into issues related to the ecosystem affects of fisheries, especially with regard to the application of the Precautionary Approach. Consequently, these activities are considered to have a very high priority.
Scientific justification and relation to action plan	**Term of Reference a)** Genomics of aquatic organisms can contribute to reduce reduction of impact of fish and shellfish diseases in several ways. Firstly, Genetically-based differences between wild or culture populations have been demonstrated in many cases. Genome scans, using microarray-based SNP genotyping technology or alternative approaches, aims at identifying regions of the genome associated with these differences in resistance/susceptibility. Secondly, genomes and transcriptome sequencing contribute to the characterization of genes involved in immune and defence systems that will help to identify genetic bases of innate and acquired resistance to pathogens. At the transcriptome level, differential gene expression of fish or shellfish exposed to pathogens, or is genetically resistant/susceptible to pathogens, can also be used to identify genes involved in response to disease. Candidate genes can then be validated using functional genomics (i.e. reverse genetics, mutagenesis, RNAi.) and/or used for marker assisted selection. Such approaches can be combined with QTL through the mapping of eQTLs, providing further links between variation for disease resistance and its molecular bases. (Lead: Pierre Bodry) **Term of Reference b)** The WGAGFM has repeatedly emphasized the need to base the management of fish stocks on population units. Unfortunately the distribution and potential migration routes of populations rarely correspond to ICES or NAFO designated management areas. Hence management units can potentially cover the distribution range of more than one population. Information on the genetic diversity, structure and stability of exploited fish stocks is essential to a sustainable exploitation and the traceability of catches and fish products. To be prepared to answer questions on the response of marine genetic diversity in times of global climate change and heavy fishing pressure, genetic sampling on a regular and systematic basis is required. Therefore ICES should propose that the European Commission integrate genetic monitoring of marine (fish) stocks into the data collection regulation (DCR). This will provide a broad and reliable baseline for management, conservation and traceability purposes. A priority list of species and recommendations for sampling, storage and molecular markers to be applied should be suggested by ICES (WGAGFM and other Expert groups.) taking into account the current genetic knowledge for the species and the availability of marker systems. To do: Priority list of species • Definition of sampling and storage protocols • Select a certain set of markers for each species • Calibration of methods between laboratories (Lead: Jochen Trautner) **Term of Reference c)** Over the past two decades, exceptional advances in molecular analytical methodologies have resulted in a myriad of new types of genetic markers. Single Nucleotide Polymorphisms (SNPs) have been one of the latest additions to the molecular toolbox. SNPs have greatly benefited from the recent development of high-throughput and relatively cost-effective genotyping platforms (e.g.

Affymetrix, SNPstream, TaqMan, Sequenom, Illumina). The unprecedented amount of genetic information provided by SNPs, make them the marker of choice for studies ranging from individual, family and population identification, to the discovery of genes and genomic regions affecting adaptive phenotypic variation. While the potential usefulness of SNPs is unquestionable, they are not without problems. For instance, to deal with the often abundant SNP genotype data (varying from a few hundred to several thousand loci at the time), generated from distinct screening platforms, quality control to ensure accuracy of allele call is a critical issue. Where data are available, there is evidence of considerable amount of genotyping error. These have been shown to potentially bias the estimation of population demographic parameters, as well as, to affect linkage analysis, measures of linkage disequilibrium, and subsequent genomic wide association studies. In addition to genotyping error, missing calls also appear to be a common feature of high-throughput genotyping. While a number of independent investigations have elaborated on these and other related relevant issues, comparatively few published studies addressing the potential caveats of SNP screening and subsequent data analysis. Given the increasing number of research groups working on fish genetics considering embracing this new molecular methodology, a review of the current state-of-the-art focusing on technical challenges, good laboratory practices, data handling and analysis would be extremely useful as a guide to users.
(Lead: Paulo Prodöhl and Phil McGinnity)

Term of Reference d)

This ToR was first elaborated in 2008 and reviewed and continued in 2009. We suggest further pursuing this effort as its underlying rationale (counteracting the dispersion and loss of valuable genetic data) is as relevant as ever, and as we also expect important steps to be made during 2009.
Despite a formal analysis of costs and benefits of creating a fish genetic meta-database not being available, the benefits are as obvious as considerable, justifying a continuation of this ToR:

- Loss of data will be avoided;
- Existing data will be assembled and is available for recurring usage;
- Superfluous efforts and costs will be reduced;
- Research coordination and collaboration will be catalysed;
- Outreach to (non-scientific) stakeholders will be improved;
- The transfer of applications based on genetics, emanating from the research realm, into fisheries management schemes will be facilitated.

Future development activities should bear some important aspects in mind such as:

- Data standards should be developed;
- (Meta)data validation and quality checks should be established, possibly through accredited laboratories;
- At some stage it a sustainable management structure has to be established;
- Compatibility with the EMODNET activity and progress of the EMODNET initiative should be monitored.

Initiatives will be taken during 2009 following the strategy outlined in this years' report, and resulting progress will be reported to the WGAGFM panel in 2010.
(Lead: Eric Verspoor, Luca Arnaudo, Jann Th. Martinsohn).

Term of Reference e)

Over-exploitation of traditional coastal stocks and a rising demand for seafood have resulted in the shift of commercial fishing towards less-known, deep-sea species in many parts of the world; by 2000, 40% of the world's trawling grounds were classed as deep sea. However the deep-sea is a cold, low nutrient environment with a slow turnover, and deep-sea species tend to be slow growing and reach sexual maturity much later than fish found in shallower, more nutrient rich waters. These properties make deep-sea fish unsuitable candidates for fishing, because stocks are highly vulnerable, and show very slow recovery after depletion. As a result, dramatic declines have been seen in many targeted species, with many stocks collapsing to <20% of their pre-exploitation

	abundance in just a few years. Catches of grenadiers, for example, peaked at 83,800 tonnes annually in the early 1970s and have been in decline ever since; the orange roughy, a species thought to live up to 150 years and only reach sexual maturity at 30 years or older, are now in significant decline due to overexploitation. Similarly, Patagonian toothfish, which can live for 50 years or more, are now targeted by a rapidly expanding, mainly unregulated fishery, and scientists fear that stocks will collapse. Despite the expanding fishery, and increasing interest from other industries, such as gold mining and oil companies, research is lagging considerably and there is limited available biological information about these species. Basic data on population structure, effective population sizes and connectivity is lacking. This ToR will summarize the available information about population genetics of deep-sea fish and identify research priorities and needs in relation to recent and future trends in deep-sea fisheries. (Lead: Sarah Helyar and Jens Carlsson) **Term of Reference f)** This is an OSPAR request (2010/3). Background: The scale of cultivation of both fish and shellfish species in coastal waters of the OSPAR area continues to increase. In some countries, the value of aquaculture products exceeds that from wild capture fisheries. Aquaculture is currently concentrated in coastal waters. taking advantage of the sheltered conditions available there, and also in response to other practical economic and engineering factors, such as accessibility for operators and to downstream processing facilities, and the difficulty and cost of maintaining structures in open water offshore areas. Some of the environmental interactions of coastal aquaculture operate on very local scales. These include enrichment of the seabed by waste feed and faeces, or the potential toxic effects of used chemicals such as medicines and antifoulants. These generally can be regulated through local licensing and consenting systems. However, other forms of environmental interactions have the potential to have influence over rather larger areas. A number of these concern wild fish populations. Examples include the pressure on wild stocks to provide raw materials (fish protein and lipid) for pelleted diets for farmed fish, interbreeding of escaped farmed fish with wild stocks reducing their fitness, and the more direct stress arising from the possible transfer of parasites of farmed to wild stocks (notably sea lice from farmed salmon to wild salmon and sea trout) and consequent impacts on wild populations. **Term of Reference g)** This strategic initiative is currently being planned and suggestions from EGs on their engagement in the SICMSP are sought. **Term of Reference h)** Collaboration across EGs is encouraged and may be facilitated by e.g. inviting EG chairs and/or key members to attend meetings of your EG, and to use teleconferencing and videoconferencing as means to engage participants remotely **.**
Resource requirements	None required other than those provided by the host institute
Participants	The Group is normally attended by some 15–25 members and guests.
Secretariat facilities	None.
Financial	None.
Linkages to advisory committees	ACOM
Linkages to other committees or groups	SIMWG , WGECO, WGMAFC, WGMASC
Linkages to other organizations	Linkage with the EC Joint Research Centre at Ispra, Italy

SCICOM Operational groups Terms of Reference 2009

2009/2/SCICOM02 A **Review Group of the Position Paper on Climate Change** (RGPPCC), chaired by Pierre Pepin*, Canada, will meet by correspondence between January and May 2010 to:

a) Identify and distributed the draft document to external reviewers with relevant expertise and/or interest for each section of the draft document to provide a ***technical (scientific)*** assessment of the material;

b) Synthesize the comments of the external reviews, edit the document with the Executive Editor to include the recommendations, and identify sections of the documents that require special attention;

c) Distribute the document with all comments to SCICOM members who will be asked to provide a review of ***policy matters*** for the entire draft document;

d) Coordinate the final discussion of required revisions to take place during a half day session at SCICOM meeting in May 2010.

The Review Group will report to the SCICOM in May 2010.

Supporting Information

Priority:	This work is of high priority for the development and implementation of ICES Strategic Plan
Scientific justification and relation to action plan:	In the background document for the Science Strategic Initiative on Climate Change (SSICC) (former SGCC) it states that the first task of the group would be to "prepare a white paper detailing current knowledge about the effects of climate change on the physical oceanographic properties of the ICES ocean areas and lower and higher level trophic responses to change, and directions that research and education should proceed in order to better understand and anticipate climate change effects on the marine environment". Council agreed to convene the group and "encouraged the Chair to broaden the scope to encompass basin scale considerations that might inter alia feed into IPCC processes" reporting to ConC and Bureau. At its February 2009 meeting, Bureau directed SCICOM to assume the governance of the climate change project. SSICC's responsibility is to prepare the draft document, which the group proposes should serve as the *official ICES view* on climate change. Publication requires SCICOM approval because the document should represent the *consensus view* of Member Nations. The Review Group's activitiy will provide the coordination mechanism for SciCom to evaluate the technical and policy aspects of the draft report.
Resource requirements:	Requires significant input from the Secretariat. Secretariat are requested to provide all relevant for all ToRs.
Participants:	Chair of PUBCOM, SSG Chairs, and members of SciCom and the Chair of ACom
Secretariat facilities:	None
Financial:	Possibly for the Chair to work with the Executive Editor to synthesize comments and recommendations from the external reviewers .
Linkages to advisory committees:	Close. Through membership of SciCom.
Linkages to other committees or groups:	Close. Through membership of SciCom.

Annex 4: Roadmap for an ICES cross-cutting programme on climate change

SCICOM Science Strategic Initiative on Climate Change [SSICC]: Roadmap 2010-2020

Prepared by the SSICC, January-March, 2010

List of contents:

1) Background
2) Mission and Scope
3) Tasks
4) Membership
5) Modus operandi
6) Outputs/deliverables
7) Timeline
8) Logistics/budget

1. Background

There is a general agreement that our understanding of the role that the oceans play in modulating the climate and the ecology of the planet is still in its infancy, and that currently described adverse impacts to the marine environment are likely only a fraction of the ones that will be described more accurately in the coming years. We risk serious degradation of marine ecosystems, which will result in undesirable consequences for human health and welfare. Credible and timely scientific information is becoming a necessary asset as nations engage in the process of responding to the challenges associated with climate change. Determining how climate change will affect all levels of biological organization requires observations, experiments and predictive mathematical models based on reliable data. Better science linked to improved risk management and adaptive management strategies will help scientists and policy makers cope with the high levels of uncertainty related to mitigation alternatives and with the range of impacts associated with climate change and variability. A much more comprehensive and robust science enterprise that incorporates a better understanding of the ocean's role in climate change is required to forecast more accurately the magnitude and the intensity of these changes at multiple scales, as well as to evaluate options for mitigation and adaptation.

Being aware of the importance of climate change and its impacts in the world's oceans and specifically in the North Atlantic, the CONC recommended after the ASC 2007 that ICES create a cross-cutting multi-disciplinary steering group made up of members from a number of the existing committees to address issues of climate change that are brought to ICES from outside sources and to formulate appropriate responses to the issues.

The ICES Steering Group on Climate Change [SGCC] was created by the Council in 2007 to look at the research, services and operational issues related to Climate Change supported by ICES in their expert groups, to assess the quality and adequacy of the assessment process, and to manage the start up transit of ICES toward the establishment of a programme in Climate Change. The life time of the group was 3 years, ending in December 2010.

In 2007, ICES initiated a process of restructuring its scientific structure and in 2008 an ICES Science Plan 2009–2013 was adopted in which climate change was considered a high research topic. The Science Plan is now in the implementation phase and one of the most interesting novelties is the possibility of establishing cross-cutting programmes and work under interdisciplinary approaches. Improving our understanding of climate change requires such interdisciplinary collaboration and, therefore, climate change should be addressed in ICES as a cross-cutting programme. Following the implementation of the new ICES Science Plan, the ICES SGCC was renamed as Science Strategic Initiative on Climate Change [SSICC] after the ICES ASC 2009 and the group was invited to prepare a workplan on climate change, which was also part of the mandate for the SGCC.

2. Mission and Scope

The mission of the ICES programme in Climate Change (or the SSICC) is to develop and maintain ICES as an effective agent to provide information on sound management in Climate Change in concert with the emerging ICES Science Strategy. This will be done by supervising the research, services and operational issues related to Climate Change supported by ICES in their expert groups and assessing the quality and adequacy of the assessment process in matters related with climate change.

The SSICC will work under an integrative view built on current ICES expertise to produce the best scientific base in climate change in order to:

a) understand the functioning of marine ecosystems under a changing climate;

b) understand the impacts of climate change on marine ecosystems;

c) identify the contribution of feedbacks from the oceans to climate change;

d) analyse uncertainties on projections/scenarios of evolution of climate change;

e) develop and evaluate options for mitigation and adaptation for a sustainable use of ecosystems;

f) promote observations and existing time series studies and the establishment of new time series with the aim of inclusion of these data sets in the ICES data holdings and make the data available in a short period of time;

g) facilitate risk analyses in climate change projections; and

h) provide information to the public and assist policy makers and stakeholders in their decisions.

The challenge is to reinforce the role of ICES as an international player to:

1) achieve healthy and productive coastal ecosystems as these have a role in mitigating the effects of climate change on coastal communities and economies in the short term; and

2) develop strategies for sustainable management of coastal and selected marine ecosystems that have significant potential for addressing the adverse effects of climate change.

3. Tasks

The SSICC will look at the research, services and operational issues, related to Climate Change supported by ICES in their expert groups to assess the quality and adequacy of the assessment process. The tasks are threefold:

Scientific:

a) Identify key connections on the biology, physical and chemical system interacting in climate change.

b) Identify sentinel and sensitive organisms and communities as indicators of climate change.

c) Integrate the oceanic observing system in risk analysis on climate change.

d) Identify and disentangle the impacts of natural climatic variability and anthropogenic drivers in marine ecosystems to enable better management.

e) Develop predictive capabilities for the impact of climate change on marine ecosystems.

Operative (strategic):

a) Integrate work of expert groups in climate change towards common and concrete objectives.

b) Promote interdisciplinary and transdisciplinary assessments on climate change issues relevant for ICES.

c) Interact with relevant organization in climate change, such as the IPCC, to support their own programmes and develop strategic alliances.

d) Facilitate the mobilization of expertise from ICES expert groups.

e) Incorporate climate experts from the fields of climatology and physical oceanography in ICES activities.

f) Identify functions and services that ICES can provide in relation to climate change in the North Atlantic to potential users and stakeholders.

Outreach:

a) Promote ICES visibility in Climate Change by the inclusion of articles in ICES Insight, supply material for ICES website, etc.

b) Promote the publication of scientific papers on climate change from relevant findings from ICES expert groups.

c) Organize periodic symposia, workshops, themes sessions, etc, on the effects of climate change in the world's oceans.

4. Membership

Two critical points that need to be considered for a smooth transition towards a cross-cutting program are the membership of the steering group and the election of the chairs.

In order to cover the appropriate range of expertise, to develop a flexible way to operate, and to establish good communication with the ICES Secretariat and with the governing bodies, the following structure is proposed for the membership of the steering group for the ICES programme on climate change (or SSICC):

- 12–13 chairs or ex-chairs of ICES WGs with expertise in climate change issues. This will ensure bottom up science, the direct links with the groups and the connections with ICES demands (e.g. OSPAR Climate request).
- 3–4 external experts in specific disciplines related to climate change, such as climatologist. This deficit of experts was noted as a severe weakness during the life of the SGCC. The number can be expanded according to the necessities and objectives.

- 2 officers of ICES secretariat: the Head of Sciences and the Head of Data Centre. The help of both has been essential during to develop the programme of the SGCC.
- 3 representatives of ICES governing bodies, e.g. 1 Vice-president, 1 member of SCICOM and 1 member of ACOM. The participation of these representatives will reinforce the communication within the ICES structure and will also serve to address the demands of ICES at different levels.

In plenary the steering group will be made up of 20–22 seats.

Regarding the composition of the steering group two things have to be considered. First, the criteria to guarantee equitable geographic and regional representation. In this respect, the regions not represented could be balanced using the quota of the external experts (that can be recruited from Universities, ESF, EU core projects, other international councils, etc.) and the representatives of the governing bodies. Second, the rotation of chairs could jeopardise the efficiency of this group. As a result, the consensus of the current SSICC was to keep the present composition of chairs and ex-chairs to ensure continuity. After 3 years the group will evaluate the experience and decide in accordance.

The chair or co-chairs of this group will be elected among the experts of the first and second groups. Co-chairs will be elected for a term of 3 years in accordance with ICES rules.

Based on our experience over the past 3, we are convinced that any continuation as a programme will require a substantial dedication from the chair, so our recommendation is that the programme has to be co-chaired.

A new chair or co-chairs for the SSICC should be elected in 2010 as the current chair is ending the 3 years mandate since the creation of the SGCC by the Council. This is also appropriate as the group is entering in a new phase and it will intend to operate as a programme.

5. Modus Operandi

The SSICC activities will be clustered around the SCICOM recommendations, and the high level objectives adopted in the ICES Science Plan, especially in the priority areas of research 'climate change' as stated in this workplan. It will take into account new and emerging issues that will require the attention of ICES. Activities will include the promotion and coordination of ICES activities in climate change (science coordination), stimulating co-operation between ICES and organisations to explore new directions (science synergy) and providing scientific criteria for ecosystem assessment (scientific services). SSICC will also promote and provide support for important international developments and events (publications, symposia, etc.).

Figure 1 shows how the SSICC envisions the cross-cutting programmes in the new structure of ICES. To operate as a cross-cutting programme the SSICC will need a high degree of flexibility, independence and authority to interact freely with the expert groups without being hampered by the different levels of decision in ICES (which could be an expected situation due to the cross-cutting nature of this programme).

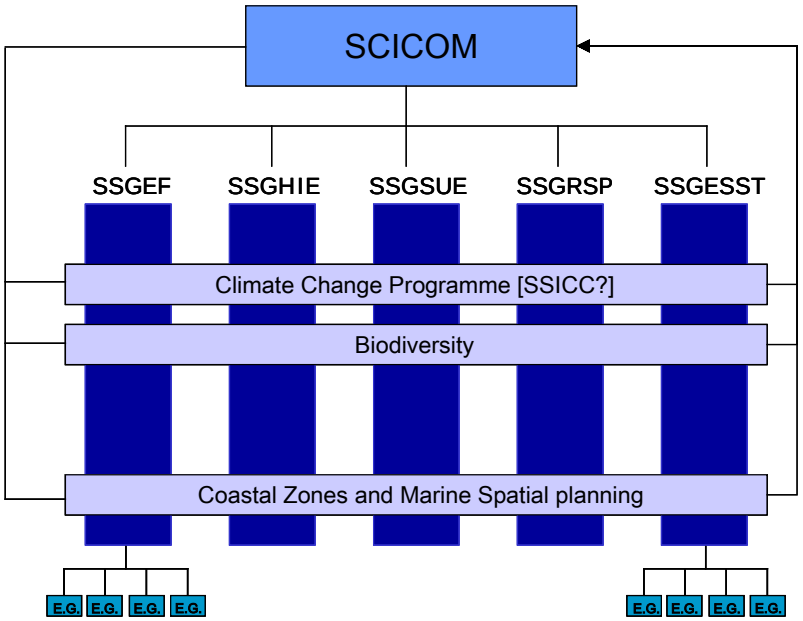


Figure 1. Diagram showing the integration of a cross-cutting Climate Change programme within the existing structure of SCICOM

The main resource for the programme is the expertise existing in other expert groups belonging to SSGEF, SSGHIE, SSGSUE, SSGRSP and SSGESST. In this respect during the last 2 years the SGCC reviewed the ToR addressed by each ICES expert group and we have now a better idea of the potential of ICES and which groups can contribute in a more effective manner.

When and where necessary, the programme will propose to SCICOM the creation of new ad hoc expert groups to cover areas of in climate change in which ICES lacks of specialist. These limited time initiatives will be in the form of Study groups, with well-defined terms of reference, open to the participation of other international experts and organizations as required and should produce a set of deliverables at the end of their term. These Study groups will report to the SSICC.

SSICC will resolve specific issues via workshops, which will work on an annual base and must report to SSICC. It is expected that each workshop result in a scientific paper.

These groups will be coordinated by a chair and supervised by the SSICC co-chairs who will foster collaboration around existing joint activities as well as new emerging activities and avoid overlap with other ongoing activities.

SSICC will propose Theme Sessions for the ASC and convene international symposia on topics related to climate change. In both cases, the cooperation with other international marine councils will be explored and promoted.

The communication policy will include articles in ICES Insight, contributions to the web page and the publications of papers in scientific journals.

SSICC plans to meet once a year in early spring, before the SCICOM spring meeting, and may hold special sessions when required (e.g. during the ICES ASC). For its deliberations, SSICC will make maximum use of electronic communication, including the use of a dedicated website.

The SSICC will report on progress directly to SCICOM as indicated in Figure 1 above. The first report will be delivered in spring 2011 and so on in successive years.

6. Outputs/ Deliverables

The establishment of such a Steering Group on Climate Change will result in the immediate visibility of ICES in climate change at different levels. In **science** it will create both expertise and capacity. In terms of **strategy** it will result in a clear advantage for ICES regarding, for instance, the new EU marine strategy and policy. On the **societal level**, it will deliver the knowledge and information needed and demanded by the general public and by the decision makers.

Other deliverables that the SSICC will provide are:

1) Report to SCICOM on annual basis.

2) Biannual report on new findings on climate change issues from scientific literature and other outcomes in climate change in the North Atlantic.

3) Organize periodic symposia, workshops, themes sessions, etc, on the effects of climate change in the world's oceans.

4) Special volumes of ICES Journal Marine Sciences following the International Symposia.

7. Timeline

The current roadmap considers that the first phase of the Climate Change programme must be limited to a maximum of ten years (2010–2020). Then the programme should be evaluated, and if the continuation is recommended it will be asked to prepare a new roadmap for a second phase.

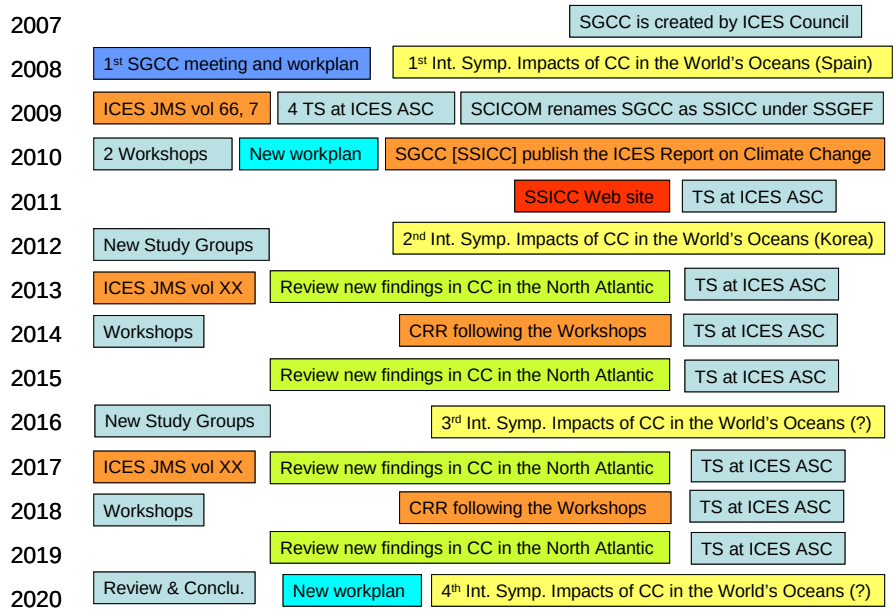


Figure 2. Timeline showing the period 2007–2010 corresponding to the SGCC created by the Council and the new phase (2010–2020) under the leadership of the SSICC.

8. Logistics/budget

There are no specific resource requirements beyond the need for members to prepare for and participate in the meeting. Thus, ICES will not provide Travel & Subsistence

for participants; these are expected from each member state or parent institutes of the experts. The SSICC will also attempt to conduct its business via electronic communication and telecommunication.

Nevertheless:

- ICES will provide meeting facilities.
- ICES will provide financial support for International Symposia on climate change promoted by the SSICC.
- ICES will cover the costs of publication and dissemination of the different publications delivered by the SSICC.
- ICES will cover other communication facilities including maintenance of a web site.
- If an extraordinary activity needs to be undertaken the SSICC will ask for support from ICES.

Final Recommendation

The SSICC encourages ICES to establish a programme in Climate Change as the main instrument of ICES work in climate change. Therefore, The SSICC recommend ICES to adopt a formal resolution from ICES governing bodies to establish such a cross-cutting programme on climate change and transform the SSICC accordingly on the basis of the roadmap prepared ad hoc.

Annex 5: Contribution of SSICC to the Science Plan High Priority Research topics

The possible contribution of SSICC to the new ICES Science Plan is summarised in the following tables, where the scores were ranked from blank (no proficiency), 1 (low proficiency), 2 (average), 3 (high proficiency)

ICES Science Plan High Priority Research Topic 1 : Understanding Ecosystem Functioning

11. Climate change processes and predictions of impacts

- 111 ICES niche: ecosystem responses to selected physical oceanographic scenarios
- 112 Define responses at the individual and population level to changes
- 113 Changes in distributional patterns at the species and community levels
- 114 Prediction of responses to selected climate change future scenarios (IPCC)
- 115 Responses based on physical-biological interactions and using long-term ICES data

	111	112	113	114	115
SSICC	3	3	3	3	3

12. Biodiversity and the health of marine ecosystems

- 121 Genetic, population, species, community levels
- 122 Relate biodiversity to resilience and plasticity of ecosystems
- 123 Define indicators of ecosystem health: attributes of ecosystems, conditions of change, external pressures
- 124 Comparative analyses to study of resilience of shelf seas exploited ecosystems

	121	122	123	124
SSICC	2	3	1	2

13. The role of coastal zone habitat in population dynamics of exploited species

- 131 Coastal zone: essential nursery grounds and home of invertebrates, critical to mariculture. These habitats are threatened by human activities.
- 132 Focus on processes linking habitat to spatial patterns at the population and community levels.
- 133 Ecosystem-based marine spatial planning
- 134 Sustaining ecosystem goods and services

	131	132	133	134
SSICC	2	3		

14. Fish life history information in support of EAM

- 141 Relate population variability, vulnerability, viability to external and ecosystem drivers.
- 142 Make use of spatial contexts and in particular operational oceanographic products
- 143 Monitor the status of populations and ecosystems with indicators
- 144 Predict population distributions, connectivity, and recruitment
- 145 Relate growth, reproduction, and feeding to the quality of habitats
- 146 Increase knowledge on fish physiology and behaviour, and their genetic basis
- 147 Processes underlying connectivity between populations: larval transport, fish movements

	141	142	143	144	145	146	147
SSICC	3			3	2		3

15. Sensitive ecosystems (deep-sea, seamounts, arctic) and data-poor species

- 151 Map habitats for conservation and management: develop habitat classification systems and mapping tools
- 152 Basic studies on the biology and ecology of these species and ecosystems in relation to water circulation, productivity, and climate change
- 153 Vulnerability to fishing: unfished deep-sea habitats, long-lived slow growing species
- 154 Rare species: genuinely rare, apparently rare to sampling
- 155 New species that are as yet unknown to science in these special environments

	151	152	153	154	155
SSICC		3			

16. Integration of surveys and observational technologies into operational ecosystem surveys

- 161 Develop an ecosystem monitoring programme with: existing time-series, emerging survey methodologies, enhanced coordination (plankton nets, acoustics, optics, trawling) and a network of fixed stations.
- 162 Aim of providing indicators in support of advisory needs of integrated management and ecosystem status reporting

	161	162
SSICC	3	

17. Role of top predators (mammals, birds, and large pelagics) in marine ecosystems

- 171 Role in the functioning of marine ecosystems: "top-down" controlled systems

- 172 Anthropogenic impact: removal of larger fish and increase top predators
- 173 Comparative analyses of ecosystem dynamics in response to changes in abundance and relative composition of top predators

	171	172	173
SSICC			

ICES Science Plan High Priority Research Topic 2 : Understanding of Interactions of Human Activities with Ecosystems

21. Impacts of fishing on marine ecosystems

- 211. Understand the impacts of fishing on all components of the ecosystem.
- 212. Gather information on biota of all types (landings, discards at sea, subject to increased mortality through unobserved interaction with fishing gear) and on habitat.
- 213. Focus on technical challenges associated with collecting and interpreting the data required to assess fishing impacts
- 214. Modify, develop, and implement fishing gears designed to minimize fishing impacts.
- 215. Strategies to reduce the costs of fishing.

	211	212	213	214	215
SSICC	1				

22. Carrying capacity and ecosystem interactions associated with mariculture

- 221. Define carrying capacity for cultured species within diverse coastal environments where there is an increasing competition for space.
- 222. Mitigation of the impacts of aquaculture through the development of multi-trophic aquaculture systems (e.g. kelp, salmon and mussel).
- 223. Interactions between wild and "farmed" species, contaminants associated with disease control and feeds, and escapement impacts.

	221	222	223	224	225
SSICC					

23. Influence of development of renewable energy resources (e.g. wind, hydropower, tidal and waves) on marine habitat and biota

- 231 Impacts on ecosystem structure and function: structural habitat features, influence on ocean circulation and mixing
- 232 Evaluate risk of potential impacts, identify mitigation options
- 233 Coordinate multi-disciplinary research to augment existing knowledge base

	231	232	233
SSICC			

24. Population and community level impacts of contaminants, eutrophication, and habitat changes in the coastal zone

- 241 Understanding the impacts of contaminants at the individual, population and community levels.
- 242 Estimating the cumulative impacts of contaminants, eutrophication, and changes in habitat substrate.
- 243 Synthesize knowledge on the impacts of diverse land-based and marine activities
- 244 Characterize the status of regional coastal zone ecosystems and causal relationships
- 245 Synthesize ecological understanding, identify gaps in knowledge and monitoring needs, based on the rich data sets for the coastal zone

	241	242	243	244	245
SSICC		1		1	

25. Introduced and invasive species, their impacts on ecosystems and interactions with climate change processes

- 251 Processes that facilitate intentional and accidental introductions of species in the North Atlantic and their drivers (e.g., role of climate change).
- 252 Impact on the distribution and abundance of native biota through niche displacement, ecosystem structure (e.g. Biodiversity) and function (e.g. food chain processes).
- 253 Risk assessment modelling for evaluation of management options
- 254 Support the development of regulatory frameworks and implementation of management measures through member countries and IMO, OSPAR, and HELCOM.

	251	252	253	254
SSICC	2	1	2	2

ICES Science Plan High Priority Research Topic 3 : Development of Options for Sustainable Use of Ecosystems

31. Marine living resource management tools

- 311 Development of indicator-based evaluations of species and habitats at different spatial scales, with reference points.
- 312 Exploration of management options under the "ecosystem approach"
- 313 Address issues associated with integrated management and conservation objectives.
- 314 Operating needs of the EAM: spatial extent of management areas, strategies to meet conservation objectives and report on ecosystem characteristics.

	311	312	313	314
SSICC	1	2	1	1

32. Operational modelling combining oceanography, ecosystem and population processes

- 321 Facilitate the availability and dissemination of long-term data
- 322 Give a reliable description of the actual marine conditions including physical and ecosystem variables, using analyses, forecasts, and model-based products
- 323 Evaluate the accuracy of the predictions as well as limits to forecasting.
- 334 Operational models to support the specific needs for the advisory process.
- 335 Forecasting of trends in recruitment as a function of oceanographic variables
- 336 Prediction of spatial pattern in populations and community properties due to changes in the environment.
- 337 Operational models to predict the development and spreading of harmful algal blooms, and environmental effects in the event of oil spills in the sea.

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33. Marine spatial planning, effectiveness of management practices (e.g. MPAs), and its role in the conservation of biodiversity

- 331 Develop and evaluate integrated management procedures of the multiple uses of the oceans, in particular spatial planning tools.
- 332 Predict benthic habitat spatial patterns based on a combination of geomorphological and oceanographic properties.
- 333 Utility of MPAs (with a range of sizes and spatial patterns) for diverse conservation objectives under Integrated Management.
- 334 Sensitivity of benthic habitats to disturbance and reference points on the limits to disturbance for a range of anthropogenic impacts.
- 335 Evaluate GIS methods with respect to the specific needs of marine spatial planning.

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34. Contributions to socio-economic understanding of ecosystem goods and services, and forecasting of the impact of human activities

- 341 Behavioural responses/strategies of the users of ocean ecosystems.
- 342 Social and economic motivations of ocean industries
- 343 How ecosystem goods and services are turned into socio-economic values.
- 344 Forecast the impact of human activities and evaluate mitigation options
- 345 Assessment of the resilience properties of marine ecosystems
- 346 Role of biodiversity at the species and genetic levels in ecosystem functioning.

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