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Executive summary

The third meeting of the ICES Working Group on Large Marine Ecosystem Best Practices (WGLMEBP), chaired by Michael O'Toole and Jan Thulin, was held at the IOC/UNESCO headquarters in Paris, France, on 3–4 July 2012. The meeting was held just prior to the 14th IOC-IUCN-NOAA Consultative Committee Meeting of Large Marine Ecosystems which permitted most participants to be present in both meetings.

A special session was held on the recently established Arctic LMEs with five presentations being given on various aspects of project development, the biology and oceanography as well as the impact of climate change on the integrity of the ecosystems. Discussions were also held concerning the management of some of the Arctic LMEs and the importance of ICES involvement in relation to the provision of scientific advice for ecosystem based management. The need for ICES to improve its communication with the Arctic council and its WGs was stressed. Better coordination in relation to integrated assessments of Arctic LMEs needs to be put in place with an honest evaluation of the effectiveness of selected indicators as tool for monitoring the status of ecosystem health. The possible establishment of an ICES Arctic LME WG was also discussed in the light of the rapid developments taking place in the Arctic and the need for more coordination. As part of the Arctic session, a comprehensive assessment of some of the international organisations involved in research, monitoring and management of the Arctic was also presented which has been included in the Annexes of this report.

The second session dealt with cooperative research and with management and capacity building activities as well as with indicators used in ecosystem assessment and resource recovery in LMEs. Among the twelve presentations given in this session, six addressed cooperative research, management and capacity building in LMEs, whereas the remainder focused mainly on best practices in international communication, information and knowledge sharing. In relation to the latter, the importance of visibility, transparency and public awareness of project activities was highlighted with a particular need to target policy makers, resource managers, regional organisations, industry, coastal communities and funding agencies. The main outlets for achieving this in LME projects were through press releases, media articles, website, brochures, scientific publications, and policy papers. The issues of data sensitivities, lack of ownership and the difficulties of communication between science and management were also raised as challenges that need to be addressed in LME project worldwide. Good progress is being made on building capacity and on implementing EAF in a number of LMEs, i.e. Bay of Bengal, Guinea Current and Canary Current through specialised courses given by, e.g. FAO, ICES and IOI. ICES has increased the scope of the courses it provides and can now offer training in integrated ecosystem assessments, climate change science and communication of science to management. Although considered expensive, these ICES courses were of great interests to the LME practitioners and ways to support attendance should be investigated. A presentation from the UNDP provided a review of the present status of the GEF LMECoP Project and the possible engagement of ICES as a partner. The development of this project application is nearing completion and will be considered by the GEF for funding in 2013.

The session concluded with a presentation on the assessment of LME scientific research which noted that it tended remain separated from mainstream marine re-

search and that not enough LME scientific work is published in international peer reviewed journals. Suggestions were made to improve this through bridging the gap between cultures and science and in providing strong mentorship from countries with more advanced marine research programmes.

1 Introduction and opening of meeting

The third meeting of the ICES Working Group on Large Marine Ecosystems Best Practices (WGLMEBP), co-chaired by Michael O'Toole and Jan Thulin, was hosted by the Intergovernmental Oceanographic Commission (IOC) at the IOC/UNESCO headquarters in Paris on 3–4 July 2012. The meeting was held just prior to the 14th IOC-IUCN-NOAA Consultative Committee Meeting of Large Marine Ecosystems which was held at the same venue on 5–6 July. Many of those attending the LME Consultative Committee meeting also attended the WGLMEBP meeting. The 2011 Terms of Reference, agenda and list of participants are given in Annexes 1, 2, 3 respectively. A copy of the agenda of the LME Consultative Committee Meeting is given in Annex 7.

Jan Thulin (Co-Chair) welcomed the participants and highlighted the objectives and terms of reference of the WGLMEBP. He briefly reviewed the agenda and drew attention to the first session on the Arctic LMEs which are of growing importance to ICES and the international community in relation to climate change and impacts on productivity and fisheries. This would be followed by other sessions which would focus on cooperative research, management and capacity building activities in LMEs, the use of indicators in ecosystem assessment and resource recovery and improving ecosystem based management in LMEs. The final session would review best practices in international communication, information and knowledge sharing in LMEs.

An important part of the proceedings would be update from UNDP on the progress and development of the GEF LMECoP project "A Global Community of Practice to improve the management of LMEs and their coasts (LME/ICM-CoP)" in which ICES, NOAA, IOC-UNESCO, IUCN and others were potential stakeholders.

2 Overview and Background

Michael O'Toole (Co-Chair) reviewed the terms of reference for the Working Group and highlighted some of the key outcomes of the previous WG meeting which was held at IOC-UNESCO Paris on 12–13 July 2011. These included the identification of training and capacity building needs for LMEs and some of the training courses on offer by various organisations and agencies. There was consensus on the need to coordinate and integrate the training needs for LMEs and the Community of Practice (CoP). The WG also discussed ways in which ICES could provide scientific support, advice and expertise to the LME Community including training in ecosystem based assessments. The need to maintain high standards in marine science, research and management was a challenge to LMEs with the Baltic Sea LME offering some useful lessons learned in terms of delivering indicators to support integrated ecosystem based management. Amongst the priority training needs identified for LMEs were:

a) Integrated ecosystem assessments (IEAs);

b) Integrated Coastal Management (ICM);

c) Climate change adaptation in LMEs;

d) Socio-economic aspects of LMEs - valuation of goods and services; and

e) Development of decision support tools for the assessment and management of LMEs.

Some of the best practices emerging from LME projects to date have been the successful use of the GEF Transboundary Diagnostic Analysis (TDA) and Strategic Action Programme (SAP) methodologies and frameworks and the formation of LME re-

gional commissions, alliances and partnerships. The main challenge remains to address training and capacity building for an estimated 10 000 LME practitioners globally. The overview concluded with an outline of the first Special "ICES - LME Thematic Session" which took place at the ICES Annual Science Conference in Gdansk in 2011. The session which comprised 18 papers/ presentations and 5 posters provided a valuable forum for exchanging ideas, sharing lessons learned and building networks between ICES and LME scientists and resource managers.

3 Presentations

The session on Arctic Large Marine Ecosystems commenced with a presentation by Hein Rune Skjoldal who provided a comprehensive overview of the Arctic LMEs and focused on structure, function, integrity and resilience of the systems. The importance of linking the ecosystems with management of human activities and of using the Ecosystem Approach framework in managing Arctic LMEs was stressed. Such a framework should include the definition and description of ecological objectives as well as an assessment and valuation in terms of managing the ecosystem using the best available scientific information. The general oceanography of the Arctic and the boundaries of its LMEs were also described along with the dynamics of the formation and melting of sea ice, its water types, mixing, nutrients and primary production. The Arctic Ocean comprises 4 layers of Atlantic and Pacific waters i.e. surface mixed layer to 50 m, the halocline layer from 50–200 m, the Atlantic layer from 200–1000 m and the basin layer > 1000 m deep. Most of the species were Arctic boreal and predominantly Atlantic rather than Pacific. A description of the main species of fish in the Arctic LMEs was given which included the polar and arctic cod, herring, Greenland halibut as well as capelin with the dominant groups being sculpins and eelpout. The main marine mammal groups comprised of 6 species of seals including ringed, spotted, hooded, harp and bearded, three species of walrus (Atlantic and Pacific) and three species of whales (bowhead, beluga and narwhale) and the polar bear. The distribution of the marine mammals were important in defining the Arctic LMEs and their components. A summary of the keynote presentation is given in Annex 5.

Gotthilf Hempel provided a synthesis of the existing international science and management organisations in the Arctic Ocean and adjacent waters. He provided an outline of the evolution of marine science and management in the Arctic and described the central role played by the Arctic Council and its member states in managing Arctic waters through its various working groups. An overview of the functions and role of various other organisations in management and marine research in the Arctic was also given including the International Arctic Science Committee (IASC), OSPAR, NAFO, ICES and the European Polar Board. The European Union also had an interest in the protection of the Arctic environment and sustainable development through its Integrated Maritime Policy (IMP). A short review document on the Arctic management organisations was prepared and distributed to working group participants and is included in Annex 5.

Vladimir Mamaev provided a presentation on "Integrated adaptive management and the current status of the GEF West Bering Sea LME in a changing climate". He outlined the financial support for the initiative which included a GEF grant of US$ 3.2 million and co-finance of US$ 10 million from NOAA, the Russian Federation, UNDP and others. The structure of the project comprised of four components include a "State of the West Bering Sea LME" within the framework of the 5 LME modules, i.e. ecosystem based management plans under climate change, target demonstration pro-

jects and learning and knowledge management. The expected outcomes of the project components will be as follows:

a) transboundary diagnostic analysis (TDA), understanding the functioning of the ecosystem and impacts of climate change, identification of knowledge gaps and local ICM plans;

b) governance reforms, improved inter-sectoral coordination in research management, improved capabilities in management and assessments, and joint management of West Bering Sea resources;

c) improved safety of maritime transport and environmental protection, cooperative management under climate change and better public awareness of environment and climate change; and

d) best practices and training exchanges.

Some of the main outputs include a geospatial data base, collaborative monitoring, ecosystem modelling and forecasting under climate change, a stakeholders participation mechanism, local demonstration projects and ecosystem based management incorporated into policies. The West Bering Sea LME Project is still in the preparation grant implementation phase (PPG) with the full project expected to commence in January 2013.

A presentation was given by Adi Kellermann on the role of ICES in the Arctic and its relationship with various organisations involved in management of the Arctic Ocean and adjacent seas. He reported that ICES are now ready to expand their work into the Arctic and have taken responsibility for climate and ocean change, e.g. Reykjanes Ridge and Siberian Shelf which are shared territories of ICES member states. The new role for ICES is being created by the retreating ice which has opened up new shelf areas for fishing activities with straddling stocks extending into the Arctic Ocean as well as the increased risks associated with shipping and alien invasive species. This requires further advisory inputs from science and management. Furthermore, the warmer Arctic Ocean is driving major changes in the marine ecosystem for which ICES has an advisory responsibility. He listed several major players involved in Arctic research including the following: the International Arctic Science Council (IASC) and the Arctic Climate Science Board; SAON Board (Arctic observation network); the Arctic Monitoring and Assessment Programme (AMAP), the North Atlantic Marine Mammal Conservation Organisation (NAMMCO); the ICES +Arctic Fisheries Working Group (AFWG) and the ICES assessment groups which target sub-arctic fish migratory stocks in the Barents Sea, East Greenland and Iceland. Other initiatives include the circumpolar Biodiversity Monitoring Programme (BMP) – a programme of the Arctic Council carried out by CAFF (Conservation of Arctic Fauna and Flora) and ESSAS, a GLOBEC regional programme. A short review of ICES partnership with IASC was given along with the potential products and inputs provided by ICES which include specialised working groups on hydrography, ocean climate, zooplankton, operational oceanography and integrated assessments.

The presentation by Anne Christine Brusendorff on the Baltic Sea Regional LME Project (BSRP) described how the GEF, ICES and HELCOM worked together to develop and implement an ecosystem approach to management for the region. The Baltic Sea LME project operated from 2003 to 2007 having a budget of US$ 16 million of which US$ 5.5 million was a grant from the Global Environmental facility (GEF). Its main regional stakeholders were HELCOM, ICES, the Swedish Agricultural University and WWF and its beneficiaries were Estonia, Latvia, Lithuania, Poland and Russia. The project was made up of two components, one comprising the Large Marine Ecosys-

tem itself and the other its land and coastal areas. The overall goal of the Baltic Sea LME project was to implement an ecosystem approach to management, reduce pollution from non point sources, to promote sustainable agriculture and fisheries and to improve living conditions. The project operational structure consisted of coordination centres (fisheries, ecosystem health, productivity, GIS data and socio-economics) in some of the countries, with designated lead laboratories and local implementation units. Institutes in Denmark, Finland, Germany, Sweden and the USA were also involved. The major outcomes of Component 1 was monitoring and assessment work, the development of ecological objectives and indicators, multiple marine ecological disturbances, and a GIS with databases. Outcomes for Component 2 included agricultural interventions, coastal zone management actions and monitoring and assessment of coastal habitats. The overall result of the Baltic Sea LME project was to build a scientific network which implemented an ecosystem approach to management and increased the assessment capacity as a basis for the HELCOM Baltic Sea Action Plan. An outline of the HELCOM Baltic Sea Action Plan (BSAP) was given, the development of which was heavily supported by the activities of the Baltic Sea LME project. The BSAP addresses the issues of eutrophication, hazardous substances, maritime activities and biodiversity/nature conservation. It envisions a healthy Baltic Sea environment with diverse biological components functioning in balance and resulting in a good ecological status and supporting a wide range of sustainable human economic and social activities. The Baltic Sea LME project was regarded as being very successful by the stakeholders and serves as a good case study for best practices and lessons learned in terms of management of GEF projects.

Nico Willemse gave a presentation on "Ecosystem indicators for sustainable fisheries and environmental monitoring" in which he briefly described the Benguela Current LME region and its importance as global centre of high productivity and valuable fisheries which contribute significantly to food security and employment especially in Namibia and Angola. An estimate of the current value of the ecosystem goods and services was given at U$ 35 billion (2010) comprising of offshore oil (74%), Diamonds (15%), Fisheries (6%) and Tourism (5%). A "State of the Stocks" report is produced each year by the Benguela Current Commission (BCC) in which the distribution, biology, stock identification and assessment, biomass indices and research on the main commercially exploited fish species are given. Environmental indicators of the BCLME such as sea surface temperature, ocean colour, and upwelling are also provided and compared with data collected over long time series. In the presentation, a number of other initiatives were outlines which make valuable contributions to monitoring and assessment work in the region. These include the NansClim project (data collection by R.V. Dr Fridtjof Nansen and analysis in relation to environmental variability and climate change) and the GENUS project (German Universities and regional stakeholders research and analysis of environmental changes in the Benguela). Other important projects include the State of the Environment Information System (SEIS) which is developing a shared information and data system between countries and a common data policy and protocol. Several challenges remain to be addressed particularly in the area of forecasting environmental variability, the uncertainties of climate change, slow progress towards managing shared stocks and limited capacity in terms of human, technical and financial resources.

Yihang Jiang made a presentation on "Nutrients as an environmental Indicator in the yellow Sea LME". He pointed out that harmful algal blooms (HABs) were identified as a priority environmental problem in the Transboundary Diagnostic Analysis (TDA) and Strategic Action programme (SAP) for the Yellow Sea and that the balance

of nutrients levels particularly phosphates, silicates and dissolved inorganic nitrogen were a major issue. He demonstrated how the Yellow Sea is affected by changes in nutrient composition and indicated measures taken to reduce nutrient discharges. The ratio of P/N was an important indicator and that levels of nitrites and dissolved oxygen were found to vary considerable in the southern part of the Yellow Sea. Although the occurrence of HABS was a major problem before 2000, there was a reduction in frequency in later years. High levels of nutrients persisted with large blooms of jellyfish *Nemopilema nomurai* occurring in 2008 over a wide area from Japan to Korea and China (Shanghai to Qingdao). Possible causes of the jellyfish blooms could be a regime shift within the pelagic ecosystem from over fishing and a change in plankton community from diatoms to dinoflagellates. He concluded with emphasising the need to reduce further the nutrients levels coming into coastal waters from the land especially from fertiliser, industrial and household waste. Further investigations need to be undertaken on the impacts of nutrient variability (N, O and Si) on plankton in the Yellow Sea LME and continuous efforts made to meet the SAP targets and reduce nutrient discharges by 10% every 10 years. The use of Integrated Multi-Trophic Aquaculture (IMTA) to reduce nutrient levels in coastal waters along with a significant cut back in fishing fleet size is seen as a major move forward towards sustainable management of marine resources in the Yellow Sea LME.

A presentation on the "Application of EAF in the Bay of Bengal LME" was given by Chris O'Brien which mainly addressed coastal marine resources management and sustainable use of the Hilsa shad and Indian mackerel. The implementation of EAF included the development of transboundary fisheries management plans, establishing working groups and management fora using the EAF framework and developing a Strategic Action Programmes (SAP). He highlighted the ecosystem based management framework used which focused on the impacts of fishing on the hilsa shad and mackerel stocks, identifying the issues and threats and the establishment of base-line information and assessment of stocks. He also stressed the needs to identify priority issues which should also include the establishment of MPAs, the development of indicators and best practices. It was essential that fisheries and the environment research and management be closely linked through cooperation between national experts and the use of national task forces and scientific advisory panels. Looking at the broader picture, it was important to consider integrated ecosystem based management and incorporate other sectors such as tourism, mining, shipping, aquaculture and agricultural practices in coastal areas into overall assessments of marine ecosystem status. The Bay of Bengal LME project is presently working with a wide range of stakeholders in implementing EAF in the region including UN agencies (FAO, UNDP, UNEP), IOC, IUCN, NOAA, BoB-IGO, IOTC, IW;LEARN, and with various universities including the "Sea Around Us Project". Building capacity was a key component of EAF application including dedicated training courses, improving communication strategy, facilitating stakeholder engagement and determining ecosystem indicators. The importance of creating regional fora, working groups and fisheries management advisory committees as a means of integrating the various components of EAF, i.e. ecosystem well being, human well being and governance was emphasised as a key activity in successful implementation.

Sambe Birane on behalf of Kwame Koranteng made a presentation on "Training in EAF management in African LME projects" and provided a brief update on the EAF Nansen project activities in LMEs which include surveys and capacity building. An outline was also given on other EAF management training initiatives, familiarisation workshops, university courses and links with other international projects such at the

CCLME, BCC and SWIOFP. The FAO EAF-Nansen project provides assistance to developing countries in Africa in particular to adopt and implement the ecosystem approach to fisheries management and to help scientists and managers to obtain additional knowledge of their marine ecosystems. The various components of the project include supporting policy formulation at national and regional level, developing EAF management plans, implementing ecosystem assessments and monitoring as well as capacity building. Training in the EAF planning process includes scoping and baseline overviews of fisheries, setting the broad objectives, identifying issues, prioritising risks, identification of management responses and indicators and cost benefit analysis.

In his presentation, Adi Kellermann provided a comprehensive overview of the ICES Training Programme including the background to developing the programme and funding mechanism. The programme is coordinated by an training officer (half-time position) and courses are largely funded through sponsorship and participants. The overall objectives of the training programme is quality assurance in support of the fisheries advisory process within ICES. The courses given ensure that participants in ICES Working Groups and other parts of the advisory process have the necessary skills to deliver high quality advice and to facilitate a common understanding for the ICES advisory process. The training courses also seek to disseminate insight throughout and outside the ICES community and to bring new disciplines and perspectives into ICES science and advice. Course announcements and registration is via the ICES training webpage www.ices.dk/iceswork/training/training.asp with course fees set as €500. Course training material is made available to participants on a protect SharePoint site. ICES training courses usually cater for between 15 and 20 persons and are open to international participants and well as those from ICES member states. A sample of recent training courses given by ICES are as follows: Stock Assessment (introduction and advanced); Ecosystem Modelling for Fishery Management; Bayesian Inference in Fishery Science; Fisheries Management to meet Biodiversity Conservation Needs; Trawl Survey Design and Evaluation; and Approaches to the Integrated Assessment of Status and Trends in Marine Ecosystems. There are also a number of new courses being given and others under development such as: Communicating Science and Advice; Climate Impacts on Marine Ecosystems and How to Lead an Effective Technical Meeting. Since that start of the ICES training programme, 22 courses have been given and were attended by 500 trainees from over 30 countries.

Werner Ekau made a presentation on "Building capacity for ecosystem based management in LMEs through specialised training" and briefly outlines a number of opportunities available in Africa. These include the AWA project on the ecosystem approach to the management of fisheries and the marine environment in west African waters (2012–2015) and the GENUS project on geochemistry and ecology of the Namibian upwelling system (2009–2012–2015). The AWA project is an integrated project to study the upwelling and coastal ecosystems of NW Africa and involves Benin, Cape Verde, Ivory Coast, The Gambia, Guinea, Guinea Bissau, Mauritania and Senegal as well as France and Germany. The project is building capacity through special course in fisheries and marine ecology, oceanography and satellite data, ichthyoplankton sampling and analysis, acoustic observations of zooplankton and the analysis of physical and chemical parameters. Masters courses in oceanography, fisheries and meteorology are also given at regional universities in Senegal and Benin and summer schools are available through the project in Europe for 10–15 participants. Hands-on training is offered on the research vessels such as the RV Maria. S.

Merian and the RV Walther Herwig. GENUS is an integrated project designed to understand the changes in biochemical fluxes and ecosystem changes related to climate and involves Namibia (UNAM, NatMIRC), South Africa (DEA) and Angola (INIP). German partners include ZMAW, ZMT, AWI and BreMare. As part of the initiative, Masters and PhD fellowships, special courses and ship-board training are offered. Other training courses available to the region are the 5 week intensive IOI course on regional ocean governance (Cape Town) and a 2 year international Master course (accredited) in tropical aquatic ecology at the University of Bremen.

Vladimir Mamaev provided an up-date of the GEF LMECoP project entitled " A Global Community of Practice to improve the management of Large Marine Ecosystems and their coasts (LME/ICM-CoP)". He outlined the project objectives which are to generate knowledge, build capacity and harness public and private partners, support south/south learning and improve the performance of IW projects through a Community of Practice for ecosystem based management approaches in relation to Large Marine Ecosystems and their coasts. The project comprised of four components which are briefly summarised as follows:

1) The establishment of a global and regional network of partners to enhance ecosystem based management and provide support to GEF IW/LME/ICM projects to address MPA needs incorporating climate variability and change;

2) The synthesis of knowledge and incorporation into policy making, the capture of best practices, the development of new methods and tools in order to enhance management effectiveness of Large Marine Ecosystems. This component will incorporate ICM, MPAs and climate variability and change within the existing 5 modules;

3) Capacity and partnership building through twinning and learning exchanges, workshops and training courses amongst LMEs and similar initiatives. Education and training modules would include ecosystem based assessments and management that would include governance under climate change;

4) Communication, dissemination and outreach of GEF/LME project achievements and lessons learned which would also increase the visibility, improve visualisation have more web presence and showcase best practices.

The GEF LMECoP project has received strong commitments of co-finance (U$ 22 million) from a number of organisations and institutions including NOAA, ICES, UNDP, IOC-UNESCO, IUCN and Conservation International. The current status of the project is that the PIF document has been completed and will be submitted along with the project preparation grant application later in 2012. It is expected that if the project is approved by the GEF Council, funding would be made available to develop the project document in 2013.

David Vousden provided a comprehensive presentation on "Best practices in communication, information and knowledge sharing in the Agulhas and Somali Current Large Marine Ecosystem". He outlined the challenges and areas of concern that needed to be addresses in terms of communication, information and knowledge sharing. Some of the key issues were:

a) Historically, the Western Indian Ocean is regarded as data poor region;

b) Limited national capacity for data capture, handling and sharing;

c) Sensitivity to data ownership and handling;

d) Lack of effective ownership of information and knowledge;

e) Poor communication and interaction across disciplines and between stakeholders.

In addition there was a disconnect between science and governance in terms of knowledge sharing, and the absence of effective engagement with the coastal communities and with the private sector. Best practices to address these issues included the holding of a Western Indian Ocean Regional Project Coordination Forum to improve communication and cooperation between stakeholder in the region. An African regional workshop for GEF IW Projects was also held and hosted by the ASCLME project in 2012 which reported on best practices and challenges in addressing priority issues and proposals for twinning projects within the region and other African LMEs. The ASCLME project has developed an "Alliance" of partners which has both scientific and policy level support for the concept from stakeholders. The project has adopted the Aide-Memoire approach between parties rather than more formal and legally binding agreements and has maintained an adaptive mechanism with regard to projects over time and with changing circumstances.

A presentation was given by Birane Sambe on "Communication, information and knowledge sharing in the Canary Current LME" which highlighted the importance of visibility, transparency and public awareness as well as adequate stakeholder involvement in project activities. Information is focused around the objectives and activities of projects as well as contributions from countries, partners and scientific research and monitoring (i.e. fisheries, biodiversity, habitats and water quality). He stressed the importance of addressing transboundary concerns through regional cooperation, the application of EAF in the CCLME and strengthening management at all levels. Communication and information sharing targeted a wide range of audiences including policy makers, resource managers. MCS agencies, regional fisheries organisations, industry, coastal communities, tourism, media and funding agencies. The main means of communication and information sharing in the CCLME project is through its website, newsletter, various workshops, publications, policy papers, fact sheets and training material. In addition, various promotion material are distributed such as brochures, posters and press releases. Out-reach activities to local communities are also valuable means of information sharing at national levels. FAO and UNEP provide good support to the CCLME project through media coverage, press releases and promotion of special events. Major constraints for the project were outlined including the complexity involving various countries at different stages of development, ensuring on-going political commitment, securing co-funding, sharing data, continued stakeholder engagement and involvement with the private sector partnerships.

Hashali Hamukuaya reviewed "Communication, information and knowledge sharing in the Benguela Current LME" both at senior management and scientific levels. These range from policy related decisions reached by Ministers at the Ministerial Conference, i.e. approval of SAP, expanding mandates of Benguela Current Commission (BCC) to include other sectors to the strategic decisions made by the Management Board recorded in minutes and meeting reports. Some of the key marine science communications include the annual state of the stocks report as well as specific assessment and monitoring surveys covering fisheries, the environment and pollution studies. Media and communication strategy covering the BCLME is mainly through newsletters, stakeholder meetings, symposia, national and regional working groups

and web-based tools and fora, i.e. D-LIST. An important means of information sharing is taking part in national, regional and international events which include the Annual Science Forum of the BCC and the Annual LME Consultative Committee meeting held in Paris at IOC/UNESCO. Collaboration and partnership with other institutions outside the region is also viewed as an important means of networking and capacity building. Data management plays a central role in the work of the BCC with a data and information management working group already in place. Regional working groups are responsible for ensuring the quality of data used in assessment and monitoring and cover such areas as stock assessment, EAF and fish ageing. Current constraints and gaps in information sharing and knowledge management include the needs for translation of key documents into Portuguese (for Angolan stakeholders), the absence of a regional data policy for the BCC, weak linkages with NGO's and industry and budgetary limitations. The relevance of work of BCC and the importance of the BCLME to ordinary peoples' lives needs to be highlighted through public events, fora, web-based platforms and social media outlets. One to one meetings with ministers, captains of industry and heads of academia are also seen as a valuable means of information sharing and communication.

The presentation by Porfirio Alvares-Torres on "Communication, information and knowledge sharing in the Gulf of Mexico Large Marine Ecosystem" outlined how regional co-operation has been strengthened through undertaking a Transboundary Diagnostic Analysys (TDA), reviewing the status and threats to the GoM-LME and the development of a Strategic Action Plan (SAP). This integrated assessment process examined the drivers, pressures and stressors impacting the ecosystem and put forward measures to reduce pollution, restore fisheries and protect the environment through implementation of an ecosystem approach to management. Part of the steps being taken to share information and knowledge are through national and regional workshops and courses and working closely with US partners through bilateral cooperation and projects. A recent example of building such links was a regional summit on the Gulf of Mexico LME held between NOAA, SEMARNAT, the private sector and various NGOs where a common ocean agenda was developed and MOUs signed between the partners in preparation for the signing of the SAP. The Joint Mexico-US Commission on Science and Technology was also highlighted as another mechanism for cooperation and information sharing in marine science and which uses the GoM-LME as a developing platform. The creation of a regional strategic academic alliance between universities in Mexico and the US is also contributing to a greater understanding of scientific knowledge in the Gulf of Mexico LME and the implementation of more effective management policies and practices for the ecosystem and economy as a whole. Other national and regional initiatives that are contribution to ecosystem based management of the Gulf of Mexico LME include the Inter-ministerial Commission for Sustainable Development of Oceans and Coasts (CIMARES), the Gulf of Mexico Alliance, the Harmful Algal Blooms Integrated Observing System (HABIOS) and the US-Mexico partnership on marine protected areas (MPAs).

The final presentation was given by Gotthilf Hempel on "Partnerships in scientific publications" who highlighted the fact that LME research was separated from mainstream marine research and that not enough work is published in international peer reviewed journals. As a result, scientific work in LME projects are not well known with much of the research being viewed by more developed countries as old fashioned, descriptive, lacking innovation and essentially data monitoring. He gave three examples of what could be done to improve the situation and concluded that patience and strong mentorship is required to bridge the gap between culture and sci-

ence in some of the LME countries. A full transcript of this talk is included in Annex 6.

4 Discussions

The presentations given during the Arctic Session were followed by a discussion on how ICES links to Arctic research, the numbers and boundaries of the LME management units and how the five coastal Arctic States manage their own areas of jurisdiction. Some of the points raised during the discussion are as follows:

- It was pointed out that the Arctic Council use ecosystem based management as a key principal action and have agreed to LMEs ocean boundary areas based on ecological criteria. Norway with the assistance of NOAA have finished a revision of a map of Arctic LMEs and submitted it to PAME for the management of marine areas. Of the 17 identified Arctic LMEs, eight are one country systems whereas others are shared LME's between two or more countries.
- ICES plays an important role in providing scientific advice to the Arctic Council on ecosystems assessments and also provides input into the Integrated Ecosystem Status Report if asked by the Council. ICES main area of responsibility is the North and NE Atlantic but it is now playing a more active role in Arctic ocean research and the provision of management advice.
- Implementing the ecosystem approach needs to be viewed in terms of managing people and human populations rather than just resources, valuing the goods and services of the ecosystem and obtaining the best scientific information available. In order to effectively manage marine ecosystems, we need to determine what the issues are, what has to be done and what are the main drivers. Decision making must be based on good indicators that are relevant and reflect the status of the ecosystem. Implementing the ecosystem approach to management is all about effective governance and having the best scientific information available for management advice.
- The Arctic Ocean and adjacent seas are sensitive ecosystems which are inhabited by about 200 000 indigenous people. Food can't be grown although there are over 200 million seabirds occurring in the Atlantic and Pacific Arctic seas. There is limited carrying capacity within the Arctic for future population growth with ecosystems facing increased environmental impacts from climate change, melting ice and increased shipping and oil and gas exploration activities. How should the international scientific community approach these issues and how can ICES move towards better communication with the Arctic Council in providing scientific advice and lessons learned from best practices especially through their specialised working groups? ICES has a data centre for pollution and has produced Climate Status Report with good understanding of climate variability. It also produces a bi-annual zooplankton report which extends to the Arctic Ocean. ICES needs to work more closely with the Arctic Council especially with AMAP and PAME and engage more with the US and Canada. It also should consider establishing stronger links between LMEs, and establish channels and platforms for better communication. In relation to integrated assessments of Arctic LMEs, there needs to be better coordination of this work with an honest evaluation of how the indicators work and whether

they are effective or not. It was suggested that ICES establish a separate Arctic LME Working Group and develop terms of references for 3 years with a work programme, defined outputs and a timetable for delivery.

- The challenge for the Arctic LMEs is the integration of ecosystem based management on a Pan-Arctic scale which also incorporates the shipping and offshore oil and gas sectors as well as socio-economics and governance. An integrated Science Plan based on similar a framework and modules as used by LMEs may provide more integration across sectors from marine science to socio-economics and governance. The LME approach provides appropriate scales which allow integration of various activities. However, there needs to be a flexible and adaptable approach and options open for using different ways depending on the ecology and the political and cultural reality. Implementing the ecosystem approach has to be science based with the necessary support of indicators which can be effectively used to assess the status of ecosystems. In the case of the Benguela Current LME, maintaining capacity in ecosystem based management was found to be difficult as trained scientists frequently leave the government civil service to join the better paid private sector. In addition, constraints in promoting and using EBM across sectors can limit the participation of private industries, i.e. oil and gas, shipping and seabed mining which requires a more focused approach. Good progress is being made on building capacity and on implementing EAF in a number of LMEs, i.e. Bay of Bengal, Guinea Current and Canary Current through specialised courses given by FAO, IOI, the R.V. Dr Fridtjof Nansen EAF programme and various international universities. ICES has increased the scope of the courses it provides and now offer training in integrated ecosystem assessments, climate change science and on the communication of science to management.
- Communication, information and knowledge sharing in LMEs takes place mainly through national, regional and international fora, symposia and conference, through websites and newsletter as well as brochures, DVDs, publications and posters. Much needs to be done regarding the standardisation and sharing of data between countries at a regional level. There are also conditions around data release, sensitivities, confidentially and formatting which will take time to address.
- The Working Group was informed that the development of the GEF LME-CoP project was progressing well with the Project Implementation Form (PIF) and Project Preparation Grant (PPG) due to be submitted to the GEF before end of 2012. Over U$22 million in co-finance has been pledged by various stakeholders with interest in participation including ICES. If approved, this project is expected to commence in late 2013.

Annex 1: WGLMEBP Terms of Reference 2011

2011/2/SSGRSP05 The **Working Group on Large Marine Ecosystem Programme Best Practices** (WGLMEBP), chaired by Michael O'Toole, Ireland, and Jan Thulin, ICES, will meet at UNESCO HQ, Paris, France, 3–4 July 2012 (in association with the 14th LME Consultative Committee Meeting) to:

a) Continue 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) Further evaluate and compare among LMEs the prescribed principal indicators used to index conditions in relation to resource recovery, climate change, and sustaining socio-economic benefits;

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

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

e) Decide upon terms of reference that relate to a work plan for the next two years that complement the ICES Science Plan and the GEF LME/ICM CoP project.

WGLMEBP will report by 15 August 2012 (via SSGRSP) for the attention of SCICOM and ACOM.

Annex 2: Agenda

3rd Working Group Meeting on Large Marine Ecosystems Best Practice (WGLMEBP)

Tuesday 3rd July 2012

14h00 – 14h20 Opening and Introduction: Michael O'Toole

Session 1 The Arctic LMEs :

14h20 – 14h50 Overview of the Arctic Large Marine Ecosystems: Hein Rune Skjoldal

14h50 – 15h10 Existing international science and management organisations in the Arctic Ocean and adjacent seas: Gotthilf Hempel

15h10 – 15h30 Overview of GEF Russian Arctic project: Vladimir Mamaev

15h30 – 15h45 Tea / Coffee

15h30 – 17h00 Discussions on lessons to be learned in relation to the Arctic from other LMEs - Panelists: Hein Rune Skjoldal, Michael O'Toole and Antonio Diaz de Leon

Wednesday 4th July 2012

Session 1 (Continued) The Arctic LMEs

09h00 – 09h15 Overview of Tuesday's deliberations: Jan Thulin/ Michael O'Toole

09h15 – 09h35 ICES activities in the Arctic: Adi Kellermann

09h35 – 10h05 The Baltic Sea LME project of GEF, ICES and HELCOM as a model: Anne Christine Brusendorff

10h05 – 10h30 Discussion

10h30 – 11h00 Tea / Coffee

Session 2 Cooperative Research, Management and Capacity Building Activities in LMEs

Indicators used in ecosystem assessment and resource recovery in LMEs

11h00 – 11h20 Developing marine ecosystem indicators for sustainable fisheries management and environmental monitoring in the Benguela Current LME: Nico Willemse

11h20 – 11h40 Indicators for monitoring ecosystem change in the Yellow Sea LME: Yihang Jiang

Capacity building for ecosystem based management in LMEs

11h40 – 12h00 Building capacity for implementation of EAF in the Bay of Bengal LME : Chris O'Brien

12h00 – 12h10 An update on the EAF –Nansen Project in African waters: Kwame Koranteng (given by Birame Sambe)

12h10 – 12h30 ICES training programme for marine scientists and managers: Adi Kellermann

12h30 – 12h50 New training initiative by the International Ocean Institute (IOI) in Namibia: Werner Ekau

12h50 – 13h00 Update on current status of the GEF LME CoP project Vladimir Mamaev

13h00 – 14h00 Lunch

Session 2 (continued) Cooperative Research and Management Activities in LMEs

Best practices in international communication, information and knowledge sharing in LMEs

14h00 – 14h15 Communication, information and knowledge sharing in the Agulhas Somali Current LME: David Vousden

14h15 – 14h30 Communication, information and knowledge sharing in the Canary Current LME: Sambe Birane

14h30– 14h45 Communication, information and knowledge sharing in the Benguela Current LME: Hashali Hamukuaya

14h45– 15h00 Communication, information and knowledge sharing in the Gulf of Mexico LME: Porfirio Alvares-Torres

15h00– 15h15 Partnerships in scientific publications: Gotthilf Hempel

15h15 – 15h45 Tea / Coffee

Session 3 Recommendations

15h45 – 17h00 Discussion and adoption of recommendations

Annex 3: List of participants

WGLMEBP Meeting, Paris, France, 3–4 July 2012

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Annex 4: Recommendations

Recognising the achievements of the WGLMEBP over the past three years in developing a dialogue between scientists and managers from LMEs all over the world and in reviewing best practices applied by them. Taking also note of the growing recognition of the LME approach in research and management, e.g. in the Arctic region including the role of ICES in this development, the WGLMEBP recommends:

1) That the Working Group continue in order to foster coordination and communication between ICES and LME projects and stakeholders addressing marine science and research management - to SCICOM.

2) That the Working Group should take into account the lessons learned in LMEs in other parts of the world in relation to best practices, use of indicators, knowledge sharing and outreach, publication and training needs.

3) That in the event of the approval of the GEF LMECoP Project and the possible engagement of ICES, a coordination centre be established in ICES fostering communication, training, capacity building and knowledge management amongst LMEs - to ICES.

4) That the Working Group continue to meet under a newly appointed joint chairmanship back to back with the next LME Consultative Committee meeting in Paris in July 2013 - to SCICOM.

Annex 5: Some international organisations related to Arctic marine research and monitoring

Gotthilf Hempel

Remark: The following summary of organizations -– mostly governmental - engaged in Arctic marine research and monitoring has been prepared for internal information of the 3rd meeting of the ICES WG on Large Marine Ecosystems Best Practices, Paris 3–4 July 2012. The list is non-comprehensive as it does not include neither UN organization like UNESCO/IOC or UNEP nor IUCN or WWF and similar NGOs. The order of the list does not reflect the relative importance for international marine research and monitoring in the Arctic Ocean and adjacent seas. I am grateful to Dr. Stefan Hain, Bremerhaven, Germany, for the compilation of much of the list which was supplemented by Dr. Hein Rune Skjoldal, Bergen, Norway, myself and others. **Gotthilf Hempel**

Introduction

In the Arctic Ocean proper, internationally organized cooperation has started much later than in Antarctic waters, mostly for political reasons. While access to the Southern Ocean is open for peaceful research by everyone, this has not been the case for the Arctic Ocean. During the Cold War the Arctic Ocean was off-limit for non-Arctic countries and research was largely in the hands of the military forces on both sides of the Iron Curtain. The only forum for scientific contacts was the International Polar Bear Agreement of 1973 between Canada, Denmark (for Greenland), Norway, USA and USSR. Since the International Geophysical Year 1958/1959 various cooperative programmes took place in the subarctic Nordic Seas mostly under the wings of the International Council for the Exploration of the Sea (ICES). In 1984 the Arctic Ocean Science Board was founded, followed by the International Arctic Science Committee (IASC) in 1990. Its functions are comparable to the Scientific Committee on Antarctic Research (SCAR) and the Convention for the Conservation of Antarctic Marine Living Resources (CAMLR). In 1987 USSR had opened the Arctic Ocean for bilateral and multilateral research projects. It took nine more years until the intergovernmental Arctic Council was established. To a certain extent it is similar to the Antarctic Treaty which is forty years older. Regulations on environmental protection and resources´exploitation have always been stricter in the far South than in Arctic and subarctic waters.

1. Arctic Council http://www.arctic-council.org

Established in 1996, the Arctic Council is a high level intergovernmental forum to provide a means for promoting cooperation, coordination and interaction among the Arctic States, with the involvement of the Arctic Indigenous communities and other Arctic inhabitants on common Arctic issues, in particular issues of sustainable development and environmental protection in the Arctic.

Arctic Council Member States are Canada, Denmark (including Greenland and the Faroe Islands), Finland, Iceland, Norway, Russian Federation, Sweden, and the United States of America. All decisions of the Arctic Council and its subsidiary bodies are by consensus of the named eight Arctic Member States.

In addition to the eight Arctic Council Member States, the Arctic Council has the category of Permanent Participants representing the indigenous peoples: Arctic Athabaskan Council (AAC); Aleut International Association (AIA); Gwich'in Council

International (GGI); Inuit Circumpolar Council (ICC); Russian Arctic Indigenous Peoples of the North (RAIPON); Saami Council (SC).

There are six Working Groups of the Arctic Council:

1) **Arctic Contaminants Action Program (ACAP)**
(see http://www.ac-acap.org)
2) **Arctic Monitoring and Assessment Programme (AMAP)**
(see http://www.amap.no)
3) **Conservation of Arctic Flora and Fauna (CAFF)**
(see http://www.caff.is)
4) **Emergency Prevention, Preparedness and Response (EPPR)**
(see http://eppr.arctic-council.org
5) **Protection of the Arctic Marine Environment (PAME)**
(see http://www.pame.is)
6) **Sustainable Development Working Group (SDWG)**
(see http://portal.sdwg.org)

Each Working Group has a specific mandate under which it operates, a Chair and Management Board or Steering Committee, and is supported by a Secretariat. Management Boards of the Working Group are typically comprised of representatives of national governmental agencies of the Arctic Council Member States, connected to the mandates of the Working Groups; and representatives of the Permanent Participants.

For the marine research and monitoring AMAP, CAFF and PAME are of particular interest

AMAP: AMAP's current objective is "providing reliable and sufficient information on the status of, and threats to, the Arctic environment, and providing scientific advice on actions to be taken in order to support Arctic governments in their efforts to take remedial and preventive actions relating to contaminants".

Within the AMAP area, 10 'key areas' have been identified that are a special focus for coordinated and harmonized monitoring and research activities. Kola Peninsula and Northern Fennoscandia; Novaya Semlya, Kara and Pechora Seas, mouth of Pechora River,; Tamyr Peninsula, Nordisk area; mouth of Lena River; Chukotsky Peninsula; Northern Alaska, North Slope; Lower Mackenzie River and delta; Canadian Arctic Islands and Arctic Archipelago;Baffin Island, West Greenland; Svalbard, East Greenland.

AMAP used the division of 17 Arctic LMEs as the geographical entities for summarizing information on environmental conditions and biology in order to identify vulnerable areas in the assessment of oil and gas activities in the Arctic. This compiled information by LMEs was also used as a basis for the consideration of environmental impacts in the Arctic Marine Shipping Assessment (AMSA). One of the recommendations of AMSA was that the Arctic States should identify areas of heightened ecological and cultural significance with regard to consider protective measures in relation to shipping (AMSA Recommendation IIC). National experts with support from AMAP and CAFF have produced a draft report where about 100 areas of heightened ecological significance have the identified in the 17 Arctic LMEs. This report is now being finalized and will be published soon.

AMAP has carried out comprehensive assessments of pollution in the Arctic, covering persistent organic pollutants, heavy metals, petroleum hydrocarbons, black carbon, and radioactivity. The major assessments are:

- Arctic Pollution Issues 1998
- Arctic Pollution 2002
- Arctic Pollution 2006, including: Acidifying Pollutants, Arctic Haze, and Acidification in the Arctic
- Arctic Pollution 2009, including separate reports on Persistent Organic Pollutants in the Arctic, Radioactivity in the Arctic, Human Health in the Arctic
- Arctic Oil and Gas 2007 (Overview report), and
- Assessment of Oil and Gas Activities in the Arctic 2010/2012

AMAP has also carried out assessments of climate issues in the Arctic, in cooperation with IASC and CAFF.

- Arctic Climate Impact Assessment (ACIA) in 2005
- Snow, Water, Ice and Permafrost in the Arctic - SWIPA 2009–2012

AMAP is currently carrying out an assessment of ocean acidification in the Arctic which will be published early next year (2013).

CAFF: The Circumpolar Biodiversity Monitoring Program is the "network of networks" coordinating the hundreds of marine, terrestrial, freshwater and coastal monitoring programs in the Arctic. It gathers, integrates, analyzes and reports data to inform policy.

CAFF published in 2010 the report Arctic Biodiversity Trends 2010'and CAFF is currently producing Arctic Biodiversity Assessment (ABA); (to be published in 2013)

PAME: The PAME Working Group's activities are directed towards protection of the Arctic marine environment. Increased economic activity and significant changes due to climatic processes are resulting in increased use, opportunities and threats to the Arctic marine and coastal environments. These predicted changes require more integrated approaches to address both existing and emerging challenges of the Arctic marine and coastal environments.

PAME's mandate is to address policy and non-emergency pollution prevention and control measures related to the protection of the Arctic marine environment from both land and sea-based activities. These include coordinated action programmes and guidelines complementing existing legal arrangements. PAME produced in 2009 the Arctic Marine Shipping Assessment (AMSA). An extensive new AMSA II C Report on "Identification of Arctic marine areas of heightened ecological and cultural significance" is on its way.

2. The Convention for the Protection of the marine Environment of the North-East Atlantic (the 'OSPAR Convention') www.ospar.org

The international, intergovernmental OSPAR Convention, 1992 is based upon (and supersedes) the Oslo Convention (1972) and the Paris Convention (1974). Under the OSPAR Convention, fifteen Governments of the western coasts and catchments of Europe (Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom), together with the European Community, cooperate to protect the marine environment of the North-East Atlantic.

The OSPAR Commission has a broad environmental mandate, including the protection and conservation of ecosystems and biological diversity; measures against discharges and inputs of hazardous substances and radioactive substances, as well as combating eutrophication. In accordance with Annex V of the OSPAR Convention, the Commission has **no** mandate as regards management of fisheries. However, where the Commission considers that action is desirable in relation to such a question, it shall draw that question to the attention of the authority or international body competent for that question (e.g. NEAFC, see below).

OSPAR measures fall into 3 categories: Agreements, Recommendations and Decisions. The latter category is legally binding for those Contracting Parties which signed the Decision (i.e. OSPAR Decisions have in this aspect a similar legal status as EU-Directives).

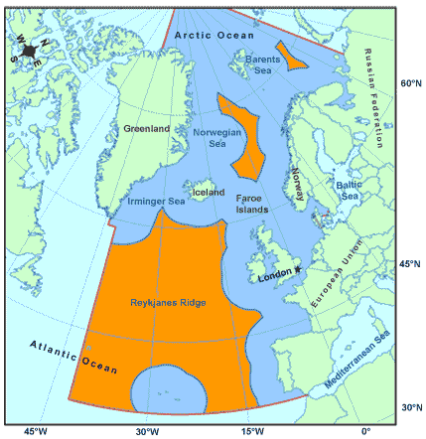
The OSPAR maritime area (see Figure above) is divided in five regions. Region I (Arctic Waters) constitutes approximately 40% of the OSPAR maritime area and is characterised by its low population density, with a total population of approximately 2.6 million. As a result, impacts of human activities related to settlements are relatively small and mostly local. Fishing and petroleum production are the most important human activities in Region I. Ocean fisheries are among the major industries in Iceland, The Faroe Islands, Norway and the north-western part of the Russian Federation. The offshore industry is of importance both in the Norwegian and Russian sectors of Region I.

One of the major recent outputs was the Quality Status Report 2010 (http://qsr2010.ospar.org/en/index.html) - a comprehensive assessment of the North-East Atlantic (see Map "Regional Summaries on prior page). Other outputs of the OSPAR Ministerial Meeting ("the North-East Atlantic Environment Summit") in Bergen in 2010 are a Ministerial Declaration and the North East Atlantic Environment Strategy (http://www.ospar.org/content/content.asp?)

3. North East Atlantic Fisheries Commission (NEAFC) http://www.neafc.org

The NEAFC Convention Area covers the Atlantic and Arctic Oceans east of a line south of Cape Farewell - the southern tip of Greenland (42° W), north of a line to the west of Cape Hatteras - the southern tip of Spain (36° N) and west of a line touching the western tip of Novya Semlya (51°E). The Baltic and Mediterranean Seas are excluded - see Map below.

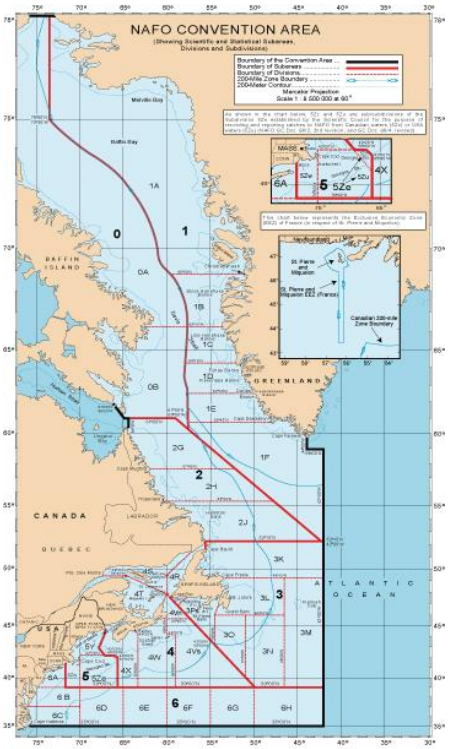
Most of this area is under the fisheries jurisdiction of NEAFC's Contracting Parties (blue areas), as it is defined as their national waters, but three large areas are international waters and constitute the NEAFC Regulatory Area (orange areas).



The North East Atlantic Fisheries Commission is made up of delegations from Contracting Parties - Denmark (in respect of the Faroe Islands & Greenland), EU, Iceland, Norway and Russian Federation - who have agreed to abide by the rules of the Convention on Future Multilateral Cooperation in North East Atlantic Fisheries, which entered into force in its current form in November 1982.

Cooperating (Non-Contracting) Parties are Canada, New Zealand, St Kitts and Nevis

NEAFC is the competent organisation for recommending measures to Contracting Parties to promote the rational exploitation of fisheries in the NEAFC area, but beyond areas under national fisheries jurisdiction of Contracting Parties. If Contracting Parties so request, NEAFC will also recommend measures for areas under the fisheries jurisdiction of Contracting Parties. NEAFC takes scientific advice from ICES, the International Council for the Exploration of the Sea.



4. Northwest Atlantic Fisheries Organization (NAFO)

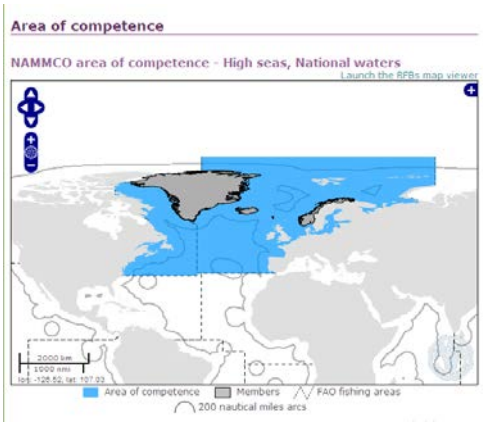
NAFO is an intergovernmental fisheries science and management body. NAFO was founded in 1979 as a successor to ICNAF (International Commission of the Northwest Atlantic Fisheries); (1949–1978).

NAFO's overall objective is to contribute through consultation and cooperation to the optimum utilization, rational management and conservation of the fishery resources of the Convention Area.

Note: NAFO is basically a 'sister' organisation of NEAFC.

The NAFO Convention on Future Multilateral Cooperation in the Northwest Atlantic Fisheries applies to most fishery resources of the Northwest Atlantic except salmon, tunas/marlins, whales, and sedentary species (e.g. shellfish). In 2009, NAFO had 12 Members from North America, Europe, Asia and the Caribbean. Among them are four coastal members bordering the Convention Area: USA, Canada, France (in respect of St. Pierre et Miquelon), and Denmark (in respect of Faroe Islands and Greenland).

5. North Atlantic Marine Mammal Commission (NAMMCO) http://www.nammco.no



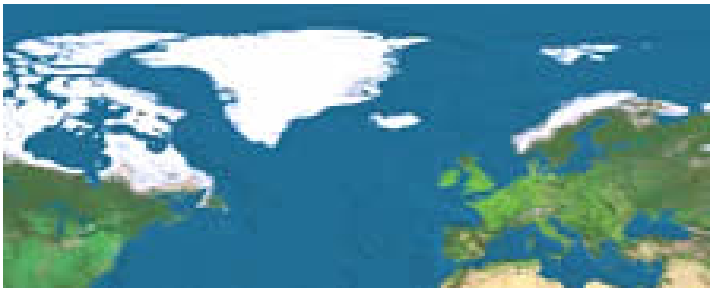
The North Atlantic Marine Mammal Commission (NAMMCO) was established in 1992. Its main objective is to contribute through regional consultation and cooperation to the conservation, rational management and study of marine mammals - all species of cetaceans (whales and dolphins) and pinnipeds (seals and walruses) - in the North Atlantic. The NAMMCO Agreement focuses on modern approaches to the study of the marine eco-

system as a whole, and to understanding better the role of marine mammals in this system. NAMMCO members are Faroe Islands, Greenland, Iceland, Norway

The NAMMCO provides a forum for the exchange of information among member countries on other matters related to marine mammal conservation and management, such as hunting methods and environmental questions.

Remark: There are some further Regional Fisheries Management Organisations (RFMOs) related to (a) specific groups of fish (e.g. North Atlantic Salmon) and/or (b) with areas of competence largely outside the Arctic proper (e.g. Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea).

6. The International Council for the Exploration of the Sea (ICES) www.ices.dk



ICES is an intergovernmental body to coordinate and promote marine research in the North Atlantic (see. map). Founded in 1902, it is one of the oldest international organisations for marine science and environment in the World.

ICES is a leading multidisciplinary scientific forum for the exchange of information and ideas on all aspects of marine sciences pertaining to the North Atlantic, including the adjacent Baltic Sea and North Sea, and for the promotion and coordination of marine research by scientists within its member nations. Its principal functions, both when it was established and continuing to the present time, are to: (i) promote, encourage, develop, and coordinate marine research; (ii) publish and otherwise disseminate results of research; and (iii) provide non-biased, non-political scientific advice to member nation governments and international regulatory commissions.

ICES works with an international community and network of over 1600 marine scientists from 200 institutes linked by an intergovernmental agreement (the ICES Convention) to add value to national research efforts. ICES has 20 member countries (Belgium, Canada, Denmark (including Greenland and Faroe Islands), Estonia, Finland, France, Germany, Iceland, Ireland, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Russia, Spain, Sweden, the United Kingdom, and the United States of America).

ICES works mainly on the following issues:

Science: ICES plans and coordinates marine research through its national delegates and through a large numbers of expert working groups on specific research and assessment issues., symposia, and an Annual Science Conference.

Advice: ICES is the prime source of scientific advice on the marine ecosystem to governments and international regulatory bodies that manage the North Atlantic Ocean and adjacent seas (incl. e.g. OSPAR, NEAFC, the EC etc.).

Marine Data: ICES maintains some of the world's largest databases on marine fisheries, oceanography, and the marine environment, and its Data Centre is part of a global network of distributed data centres.

Publications: ICES publishes its scientific information and advice in reports, publications (including the *ICES Journal of Marine Science*), electronic media, and on the ICES website.

7. The North Pacific Marine Science Organization (PICES) http://www.pices.int

PICES, an intergovernmental scientific organization, was established in 1992 to promote and coordinate marine research in the northern North Pacific and adjacent seas (basically a sister organisation to ICES). Its present members are Canada, Japan, People's Republic of China, Republic of Korea, the Russian Federation, and the United States of America

The purposes of the Organization are as follows:

- Promote and coordinate marine research in the northern North Pacific and adjacent seas especially northward of 30 degrees North
- Advance scientific knowledge about the ocean environment, global weather and climate change, living resources and their ecosystems, and the impacts of human activities
- Promote the collection and rapid exchange of scientific information on these issues.

8. The International Arctic Science Committee (IASC) http://iasc.info

The International Arctic Science Committee (IASC) is a non-governmental, international scientific organization, founded in 1990. The IASC mission is to encourage and facilitate cooperation in all aspects of Arctic research, in all countries engaged in Arctic research and in all areas of the Arctic region. Overall, IASC promotes and supports leading-edge multi-disciplinary research in order to foster a greater scientific understanding of the Arctic region and its role in the Earth system.

To achieve this mission IASC:

- Initiates, coordinates and promotes scientific activities at a circumarctic or international level;
- Provides mechanisms and instruments to support science development;
- Provides objective and independent scientific advice on issues of science in the Arctic and communicates scientific information to the public;
- Seeks to ensure that scientific data and information from the Arctic are safeguarded, freely exchangeable and accessible;
- Promotes international access to all geographic areas and the sharing of knowledge, logistics and other resources;
- Provides for the freedom and ethical conduct of science;
- Promotes and involves the next generation of scientists working in the Arctic; and

- Promotes bipolar cooperation through interaction with relevant science organizations.

IASC is governed by a Council consisting of one delegate appointed by each of the 21 national member organizations from Canada, China, Czech Rep., Denmark/Greenland, Finland, France, Germany, India, Italy, Japan, The Netherlands, Norway, Poland, Russia, Republic of Korea, Spain, Sweden, United Kingdom and USA. These organizations are scientific bodies covering all fields of Arctic research. Each organization has its own mechanism for ongoing contact between the IASC Council and its Arctic science community.

IASC partner organizations include inter alia (full list on http://iasc.info):

International Association of Cryospheric Sciences (www.cryosphericsciences.org)

International Council for Science (www.icsu.org)

International Network for Circumpolar Health Research (www.inchr.com)

International Permafrost Association (http://ipa.arcticportal.org)

Northern Research Forum (www.nrf.is)

Ny-Ålesund Science Managers Committee (www.npolar.no/nysmac)

Pacific Arctic Group (http://pag.arcticportal.org)

Scientific Committee on Antarctic Research (www.scar.org)

University of the Arctic (www.uarctic.org)

World Climate Research Program (www.wcrp-climate.org)

The core elements of IASC

IASC Action Groups (AGs) provide strategic advice to the Council and Working Groups on both long-term activities and urgent needs. They are dynamic groups that act within a limited timeframe of two years.

IASC Advisory Groups address a more structural need on recurring or ongoing research topics. These groups work with a long-term vision and provide in-depth scientific and technical expertise in their field of competence

Working Groups (WGs). IASC WGs identify and formulate science plans, research priorities, encourage science-led programs, promote future generations of arctic scientists and act as scientific advisory boards to the Council. Currently there are five IASC Working Groups (Terrestrial; Marine; Cryosphere; Atmosphere; Social&Human).

The marine WG of IASC is the former **Arctic Ocean Science Board**, established in 1984. Its present scientific foci are:

Arctic Ocean System: Predicting and Understanding Rapid Changes in the Arctic. There is widespread agreement that the Arctic Ocean is now in a state of rapid transition with potentially tremendous economic, social and environmental consequences. This transition is best exemplified by the marked reduction in sea-ice cover witnessed in instrumental records over the last 30 years. Scientific knowledge of the present status of the Arctic Ocean and process-based understanding of the mechanisms of

change are required to make useful predictions of future conditions throughout the Arctic region.

These predictions are also urgently needed to plan for the consequences of climate change. For example, understanding the feedbacks between physical and biogeochemical components of the Arctic Ocean are extremely important not only for the Arctic environment but for the global community as well. The Marine WG intends to play a leading role to further our understanding of this complex system.

Sea ice, its structure, dynamics and role in the Arctic system. The IPY has provided a wealth of extensive and intensive observations of the Arctic Ocean, of its hydrography, circulation and interaction with other parts of the Earth climate system. At the same time, nature exhibited a most drastic example of Arctic change by creating the smallest summer ice extent observed to date - an event that defied the model projections, and whose occurrence and consequences have been analyzed and debated, without conclusive answers being found.

Building on knowledge gained during the IPY and on new observational technologies the Marine WG will endeavour to better understand sea ice structure, its growth and decay and its dependence and dynamical interactions with the radiation balance, the atmosphere and the ocean within the Arctic system. It will also include evaluation on the impacts of these changes on the associated sea ice biota.

Ecosystem responses to changing physical parameters in the Arctic. Although recent major changes in the physical domain of the Arctic are well documented, such as extreme retreats of summer sea ice in 2007, large uncertainties remain regarding potential responses in the biological domain. Reduction in sea ice extent in the Arctic has been seasonally asymmetric, with minimal changes until the end of June and delayed sea ice formation in late autumn. The effect of this seasonal asymmetry in sea ice loss on ocean primary production is equivocal, with satellite images showing variable chlorophyll concentrations with no secular shifts for the region as a whole. However, clear changes have occurred at higher trophic levels, including shifts in species ranges for zooplankton, benthos, and fish, and loss of sea ice as habitat and platform for marine mammal species. The Marine WG intends to play a role in increasing our understanding of potential ecosystem changes under further loss of sea ice.

Understanding Geochemical process in the Arctic Ocean and Sub-Arctic Seas. The changes in the sea ice coverage of the Arctic Ocean, present and predicted for the future, will likely have major impacts on the fluxes of chemical constituents as well as the ventilation of deep waters.

The Arctic Ocean system is moving from a state where the biological productivity mainly has been confined to the shelf areas to a situation with potentially higher activity over the deep central basins. Such a change could increase the export production that would result in a change of the biogeochemistry of the deep and bottom waters. The Marine WG will promote in-depth studies of relevant properties of the full water column of the central Arctic Ocean.

Facilitating Deep Sea drilling in the Arctic Ocean. The Arctic appears to be changing faster than any other region. To understand the potential extent of high latitude climate of the Arctic. The Marine WG intends to support the collection of a long-term geological record of the Arctic Ocean in order to supplement current and long time series observations which are vital to improve our understanding of Arctic processes.

Cross-cutting. The following three general themes were identified as important cross-cutting issues which should be addressed by most, if not all, the IASC Working Groups: How will the diminishing ice cover affect the carbon cycle in the Arctic and what are the impacts? How does the variability of different components of the Arctic system impact the heat and momentum exchanges between ocean, ice, atmosphere and space in a changing climate? How will changes in the hydrological cycle impact various components of the Arctic system?

9. European Union

The EU is gradually formulating a policy on Arctic issues to address EU interests and responsibilities, while recognising EU countries' legitimate interests and rights in the region.

EU policies in areas such as environment, climate change, energy, research, transport and fisheries have a direct bearing on the Arctic and contribute significantly to its protection. It is a fundamental premise of the EU's Integrated Maritime Policy that each sea-region is unique and needs individual attention in balancing its uses in a sustainable manner.

The EU Arctic policy is built around three main policy objectives:

- Protecting and preserving the Arctic in unison with its population;
- Promoting sustainable use of natural resources;
- Contributing to enhanced governance in the Arctic through implementation of relevant agreements, frameworks and arrangements, and their further development.

The EU is conscious of the need for international cooperation on Arctic issues, and recognises the important role of the Arctic Council. It also participates in the Barents Cooperation, and addresses Arctic issues through its Northern Dimension policy.

Important documents and texts:

- **20 January 2011 on a sustainable EU policy for the High North** (http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P7-TA-2011-0024+0+DOC+XML+V0//EN)
- **2009 Council conclusions on Arctic issues**
- **2008 Commission communication on EU & Arctic region** http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:DKEY=483680:EN:NOT)

10. European Polar Board (EPB)

The European Polar Board (EPB) is Europe's strategic advisory body on science policy in the Arctic and Antarctic. It is a platform for European engagement in international science programmes and provides strategic science policy advice to the European Commission and international bodies. [1] The EU has so far no observer status in the Arctic Council. The EU supports a wide range of activities in the Arctic, *inter alia* in the context of large, multidisciplinary research projects such as SIOS (see below).

Strategic Priorities and Actions: Being a facilitator of scientific activities in the Polar Regions and having a European-wide view upon these activities, the European Polar Board identified topics that are of main interest to foster scientific perspectives in the Arctic and Antarctic.***European Polar Research Programmes** - Launching joint pro-

grammes such as **PolarCLIMATE** and future research opportunities ***ERICON AURORA BOREALIS** - development of a long term European plan for arctic global change research and proposals for a new dedicated European research icebreaker.

***Research Infrastructures** - European Nations control a significant proportion of medium to large scale research infrastructures in the Arctic and Antarctic. There is a large number of Terrestrial stations including the cluster of facilities on Svalbard in the Arctic and throughout the Antarctic peninsula and plateau. There is a trend towards maximizing the impact of research activities into the efficient sharing of resources and infrastructure. Europe operates a suite of world leading polar class research Ice breakers and ice strengthened oceanographic research vessels. A new Air support network for the Antarctic has recently been established. The European Polar Board recognizes the need to influence European and National funding agencies to support the creation of new Polar research infrastructures and to manage the efficient use of existing facilities to enhance scientific deliverables and provide timely and reliable science advice to European governments.

***International cooperation** - The European Polar Board promotes Science and technology cooperation in the Polar regions with its international partners. A dialogue with the managers of the United States Office of Polar Programs and European Polar Agency concentrating on areas of mutual scientific and logistical interest has been initiated. An unprecedented level of multilateral cooperation resulted from the planning and implementation of the International Polar Year 2007/2008. European Nations played an important role in this process. New areas of polar science such as Astronomy and Astrophysics have been supported through international workshops and development of a task-force from Europe, the US and Australia. A multinational consortium is being planned to construct a state of the art Research Icebreaker with a deep drilling capability for the central Arctic. The European Polar Board is also leading the way in the establishment of a Southern Ocean scientific committee to focus on understanding circulation and carbon fluxes in this critical area.

***Science Policy** - The European Polar Board established a high-level European Strategic framework for science and operational capabilities in the Polar Regions (EUROPOLAR). The elements include a Research Icebreaker capability for the high-Arctic; An intercontinental Polar Air Support network; new European led terrestrial research facilities such as CONCORDIA station and space/ground based observational and monitoring capacities for the Polar Regions.

Two examples of large scale international projects

Sustaining Arctic Observing Networks (SAON) www.arcticobserving.org

SAON is a process to further multinational engagement in developing sustained and coordinated pan-Arctic observing and data sharing systems that serve societal needs, particularly related to environmental, social, economic and cultural issues. SAON is supported by the Arctic Council (via AMAP) and IASC. The SAON membership is composed of Arctic Council members, the AC Permanent Participants, non-Arctic countries (IASC members) engaged in Arctic observations, such as Germany or China) and relevant international organisations (e.g. WMO, ICES).

The SAON mission is to develop a set of recommendations on how to achieve long-term Arctic-wide observing activities that provide free, open and timely access to high quality data that will realize pan-Arctic and global added-value services and provide societal benefits.

In order to achieve this mission, SAON members put forward "Task Proposals" for joint workshops, for improving of networks or for a better handling of data (management, access, visualisation etc.).

The goal of developing SAON dates back to 2006, when Arctic Council Ministers requested the AMAP to cooperate with the other AC working groups, IASC and other partners in efforts to create a coordinated Arctic Observing Network that meets identified societal needs. Subsequently, SAON workshops were held in 2007 and 2008, and a SAON Steering Group was established in 2009. The first SAON Board meeting took place in January 2012, which *inter alia* discussed and initiated an ongoing process for establishing SAON Terms of Reference.

Svalbard Integrated Arctic Earth Observing System (SIOS) http://www.sios-svalbard.org

SIOS is an example of a large EU-funded research project in the Arctic - the EU contribution to the SIOS-Preparatory Phase project alone amounts to €4 million. It is one of the proposals from Norway accepted for the 2008 Roadmap of the European Strategy Forum on Research Infrastructures (ESFRI).

SIOS has nearly 50 partner institutions from a variety of countries, 27 official "formal" partners and 23 associated partners.

The goal of SIOS is a better understanding of ongoing and future environmental and climate related changes, which require an integrated - Earth System - approach, in particular in the polar regions. While Earth System Models already have reached far in the integration process, observation systems have not been developed with the same systematic approach so far. SIOS envisages to fill this gap at a regional scale by:

- Establishing an Arctic Earth Observing System in and around Svalbard that integrates and complements existing research and monitoring platforms for geophysical, biological and chemical studies with the aim to match integrated models;
- Utilizing satellite remote sensing data that are available via the Svalbard receiving stations and the space agencies using this station;
- Building up close cooperation with other ESFRI projects that plan activities in the European Arctic, existing regional research networks in the European Arctic and to pan-Arctic initiatives such as the Sustained Arctic Observing Network (SAON).

Annex 6: Partnership in scientific publications

Gotthilf Hempel

Two observations:

1) LME research and the LME community are somewhat separated from the main stream of academic marine research. That is detrimental to the flow of scientific information and ideas and to the recruitment of academically well trained and highly motivated young scientists to become LME practitioners.

2) The majority of LME scientists/ practitioners publish very little in international journals.

My credo: Partnership is needed between scientists who are familiar with mainstream scientific publishing and LME practitioners.

1) LME work vs. Academic mainstream: The work done in the LME projects is not well known to the outside scientific world which often considers it as pedestrian routine rather than innovative. In fact, much of the data collection and monitoring work for the five modules has to be routine in order to provide the information needed for advice to management. However the trans-disciplinary approach of the five modules and the large multi-disciplinary data sets offer new insights into ecological processes and socio-economic interactions. Those insights should be of interest to basic marine ecology and integrated modelling. They should be published in leading journals for marine ecology and coastal management. Publications of that kind would also increase the awareness and recognition of LME work by the academic marine community and might prompt first class young marine scientists to join LME teams.

2) Involvement of LME practitioners in scientific publishing: Large data sets, partly of long time series of observations in the first three modules of LME work have been accumulated (and hidden) in the grey literature of LME reports and in national institutions. Academic scientists making use of data sets originated by LME projects should actively involve local scientists as co-workers and co-authors in the analysis and application of the data and in the process of writing and publishing the results. Much information has been produced in the course of MSc and PhD theses supported by fellowships. After the process of graduation the young scientists and their professors are relieved and do not bother much about proper publication of at least part of the results. Often it needs a strong push and patient help by the professor to achieve such publication. Mentoring should not end with the degree.

Three examples

1) When compiling class room textbooks on marine and polar ecology I included chapters on the LME concept in order to familiarize "ordinary" students and school teachers with the LME approach.

2) Earlier this year I helped a former African Ph.D. student in the publication of parts of his thesis on local artisanal fisheries and fishing communities at an African coast. The study deals inter alia with the conflicts between the traditional fishing rules based on taboos and governmental regulations as

well as with the failure of the top-down introduction of a MPA in contrast to the success of bottom up community-based control. It is not easy to present those observations in a form which will survive the peer review system of a prestigious international journal. It might have been easier for both of us if I would have written a draft on the basis of his thesis but I would have missed much information and explanation which came up in the process of joint writing. In this process he improved his skills in modern scientific writing and developed much scientific self-confidence. The next paper he will do on his own.

3) At a Russian-German workshop in Murmansk early last year Gennady Matishov and his colleagues presented reviews in English on the work of the Murmansk Marine Biological Institute in the Barents Sea, including the time series of more than hundred years of observations at the Kola Meridian between Kola Peninsula and Nowaya Semlya. We felt that those reviews should be made accessible to the outside science community by publishing them in Reports on Polar and Marine Research, an internationally recognized non-peer-reviewed publication series of Alfred Wegener Institute Bremerhaven. Gennady Matishov prompted his colleagues to deliver draft papers in time. Roman Mikhalyak translated and polished them and I volunteered to edit them scientifically by bridging the gap between the Russian and Western cultures of scientific writing. The Russian authors were very cooperative and after ten months of hard work the volume was published very much to the pleasure and pride of all its fathers and mothers. Again the work was very rewarding to me

The present scientific system in many parts of the world is highly competitive and builds on the principle of "publish or perish". LME work everywhere should be built on partnership under the motto: "**Publish and flourish**"

Annex 7: Agenda IOC-IUCN-NOAA Large Marine Ecosystem 14th Consultative Committee Meeting at UNESCO, Paris, France, 5–6 July 2012

DAY 1 – July 5, 2012

TIME	TOPIC	SPEAKER
9:00 am – 12:15 pm		
	IOC WELCOME	**Wendy Watson-Wright** **Luis Valdes**
	ADVANCING SUSTAINABLE DEVELOPMENT IN LMEs DURING CLIMATE CHANGE	
	Accelerated Warming & Emergent Trends in Large Marine Ecosystems	Kenneth Sherman
	Humboldt Current LME	Michael Akester
	Fisheries Condition & LMEs of the World	Daniel Pauly
	ICES Working Group on LME Best Practices: Meeting Report for 2012	Michael O'Toole Jan Thulin
10:30 am – 10:45 am	**COFFEE/TEA**	
	The Transboundary Waters Assessment Programme (TWAP) Revision	Julian Barbiere Sherry Heileman
	The Integration of LME-ICM Projects	Ivan Zavadsky
	The Complementarity of Conservation International and LME Projects	Andrew Rosenberg Leah Karrer
	Catalyzing Ocean Finance for LME Protection & Restoration: Case Studies from the UNDP/GEF LME Portfolio	Andrew Hudson
	The Assessment & Management of the GCLME	Jacques Abe Stephen "Max" Donkor, Christian Susan
	Monitoring Climate Change in African LMEs	Justin Ahanhanzo
12:15 pm – 1:30 pm	**LUNCH**	
1:30 pm – 5:00 pm	**Topic – cont'd**	
	Joint US-Mexico Assessment & Management of the Goods and Services of the Gulf of Mexico LME	Antonio Diaz de Leon Porfirio Alvarez Bonnie Ponwith
	Marine Spatial Planning as a Framework for the Sustainability & Management of LMEs	Barry Gold
	FAO Supported GEF LME Projects and the *RV Nansen* Operations	Kwame Korentang

DAY 1 – JULY 5, 2012 (cont'd)

TIME	TOPIC	SPEAKER
	A Study on Socioeconomic Importance of Small Pelagic Fish in the Canary Current LME	Birane Sambe
	Ecosystem-based Approach to Assessment & Management of Bay of Bengal LME Goods & Services	Chris O'Brien Rudi Hermes
	IUCN Activities Related to LMEs	James Oliver Aurelie Spadone
5 pm – 3:30 pm	COFFEE/TEA	
	Assessing the Changing States of the Goods & Services for the Agulhas Current & Somali Current LMEs (ASCLME)	David Vousden Magnus Ngoile
	Sulu-Celebes Sea LME: Lessons Learned in LME Management	Annadel Cabanban
	Environmental & Economic Benefits of the Management Actions in YSLME: Knowledge & Experiences Waiting for Actions	Yihang Jiang
5:00 pm	ADJOURN	

DAY 2 – July 6, 2012

TIME	TOPIC	SPEAKER
9:00 am – 12:00 pm	ADVANCING SUSTAINABLE DEVELOPMENT IN LMEs DURING CLIMATE CHANGE (cont'd)	
	Actions in Support of the Sustainability & Development of the Benguela Current LME in Relation to Climate Change	Hashali Hamukuaya Nico Willemse
	Ecosystem-based Assessment & Management of Arctic LMEs	Hein Rune Skjoldal
10:30 am – 10:45 am	COFFEE/TEA	
10:45 am – 12:15 pm	Topic – cont'd	
	Multidecadel Changes in Russian Arctic LMEs	Gennady Matishov
	Action for Improving Conditions of the Mediterranean LME Goods & Services	Virginie Hart
	The Indonesian Sea GEF-LME Project	Gabriel "Tonny" Wagey

DAY 2 – July 6, 2012 (cont'd)

TIME	TOPIC	SPEAKER
12:15 pm – 1:30 pm	LUNCH	
1:30 pm – 6:00 pm	Improving Conservation & Sustainability of the Yellow Sea	Young Cheol PARK
	West Bering Sea LME Project Update; Antarctic	Vladimir Mamaev
	The Caribbean Sea LME Project	Patrick Debels
	Biodiversity Information for Evaluating Climate Change Impact on LMEs	Villy Christensen
	LME & ICES Science	Adi Kellermann Yvonne Walther
3:00 pm – 3:15 pm	COFFEE/TEA	
3:15 pm – 6:00 pm	BEST PRACTICES FOR CAPACITY BUILDING & MODELING FOR LMEs	
	LME Practitioners & CoP Support	Vladimir Mamaev
	Commentary & Summary	Gotthilf Hempel
	Discussion/ Planning Session LME Consultative Committee 2012-2013	Chair & ALL
6:00 pm	ADJOURN	