Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs)

Fourth Session

Paris, France
8-9 January 2002

UNESCO

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Abstract
The Fourth Consultative Committee Meeting on Large Marine Ecosystems (LMEs) was held on 8-9 January 2001. The consultation was convened by the Intergovernmental Oceanographic Commission (IOC) of UNESCO, the US Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), and the World Conservation Union (IUCN). It was sponsored by IUCN and hosted by IOC at the United Nations Educational, Scientific, and Cultural Organization's (UNESCO) headquarters, Paris, France. The meeting was co-chaired by IOC Executive Secretary, Dr. Patricio Bernal and Dr. Kenneth Sherman of NOAA-NMFS. The agenda and a list of attendees are given in Annexes I and II.

(SC-2002/WS/52)

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1. INTRODUCTION

Dr. Bernal, the IOC Executive Secretary, welcomed the participants to UNESCO and commented on the continuing interest on the part of IOC in the development and implementation of the growing number of the science-based LME projects, participating among the developing countries as an important post-UNCED movement toward more sustainable coastal resources and environments. Dr. Sherman noted that the combined efforts of the IUCN, the IOC, and the NOAA resulted in considerable progress in LME assessment and management activities since the last meeting held in June 2000; the number of countries participating in LME projects reached 60, with the level of financial support climbing to $150 million.

Carl Lundin of the IUCN reported that the World Conservation Union remained committed to providing scientific and technical assistance to developing countries moving forward the implementation of LME projects in Asia, Africa, Latin America, and Eastern Europe.

2. REPORTS ON THE PLANNING AND IMPLEMENTATION OF LARGE MARINE ECOSYSTEM ASSESSMENT AND MANAGEMENT PROJECTS

The Committee welcomed a series of presentations on the status of LME planning and implementation for projects around the globe.

2.1 BENGUELA CURRENT LME

Dr. Michael O'Toole presented the Committee with a briefing on the successful Block B phase of the Benguela Current LME (BCLME) project along with the highlights of the Strategic Action Programme (SAP) to be initiated during the implementation phase of the project. Based on the excellence of the analyses conducted during the preparatory Block B series of workshops with key stakeholder groups, the SAP phase is to be funded at a level of $38 million. Of this amount, $18 million is to be financed by the GEF, to cover "incremental costs" over five years. The matching funds of $20 million represent baseline commitments to the project in personnel and facilities made available by Angola, Namibia, and South Africa, the three participating BCLME border countries.

The Transboundary Diagnostic Analysis (TDA) document focused attention on the unique high productivity of the ecosystem and serious shortcomings in realising the full socio-economic potential of the ecosystem because of over-fishing, harmful algal blooms, less than optimal industrial practices in offshore oil production, diamond mining, and fishing practices, particularly in relation to resource allocation between industrial and artisan fishermen.

In addition to the joint fisheries surveys and assessments planned by the participating countries (Angola, Namibia, South Africa), the principal ministries serving as stewards of the environment and natural resources in each of the three countries (e.g., Environment and Tourism; Fisheries; Petroleum; Mining and Energy) signed and adopted the SAP. In addition, the ministries established a new precedent for a Large Marine Ecosystem. They established an organization under the terms of the Law of the Sea (UNCLOS), entitled *The BCLME Programme*, complete with 10 Principles to be followed, and 7 new Institutional Arrangements to carry the BCLME Programme forward. The key instrument for Programme implementation is the Interim Benguela Current Commission (IBCC). It was established to strengthen regional co-operation and be fully supported by a Programme Coordinating Unit (PCU) and subsidiary bodies, such as Advisory Centres and Groups. The IBCC will become a fully functional Benguela Current Commission (BCC) with a supporting Secretariat within a period of five years after formal commencement of the BCLME

Programme. Five Advisory Groups will support the IBCC: (i) Advisory Group on Fisheries and Living Resources, (ii) Advisory Group on Marine Environmental Variability and Ecosystem Health, (iii) Advisory Group on Marine Pollution, (iv) Advisory Group on Legal Affairs and Maritime Law, and (v) Advisory Group on Information and Data Exchange. The full title of the historic Strategic Action Programme is *Integrated Management, Sustainable Development, and Protection of the Benguela Current Large Marine Ecosystem (BCLME).*

2.2 YELLOW SEA LME

Professor Qisheng Tang indicated that good progress was being made on the completion of the initial Block B phase of the Yellow Sea (YSLME) project. China and Korea have agreed to co-operate in a 5-year $25 million GEF-funded strategic action plan (SAP) for the project. The project is based on transboundary diagnostic analysis (TDA) conducted jointly by scientists and marine policy experts from both countries. The key components of the project will include joint surveys and assessments of the fish and fisheries of the Yellow Sea LME, assessments of the productivity carrying capacity, pollution, and health of the ecosystem. Special attention is to be focused on the socio-economic benefits to be realized from improvements to the environment and sustainable development of the goods and services provided by the ecosystem for the densely populated coastal urban Centres located along both the Korean and Chinese coasts of the ecosystem. Professor Tang also described innovative Global Oceans Ecosystems Dynamic (GLOBEC) projects initiated by China for the Yellow Sea, Bohai Sea, and East China Sea. He stressed the complimentarity among the more basic science-oriented GLOBEC studies and the applied surveys and assessments to be made during YSLME implementation to support joint Chinese and Korean management practices.

2.3 CANARY CURRENT LME

Barbara Cooney of the FAO, Rome, and Ndiaga Gueye provided an update on the planning for the GEF-supported Canary Current project, and the status of the GEF Block B planning grant for the "Protection of the Canary Current Large Marine Ecosystem". The draft Canary Current Block B LME Project planning document is presently under review by the participating countries.

A brief presentation on the objectives and activities of the Canary Current LME PDF B initiative was made by Dr. Ndiaga Gueye from Senegal. Included in this cooperative activity are seven coastal countries bordering the LME on the northwest Africa coast, including Morocco, Mauritania, Senegal, Gambia, Cape Verde, Guinea-Bissau, and Guinea. During the planning phase, emphasis will be on preparation of a TDA and SAP as in the other GEF-funded LME projects in West Africa. It was made clear by Dr. Gueye that fish and fisheries are a high priority transboundary issue critical to the food security for the people inhabiting the region, particularly in Senegal and Mauritania, and will be a major focus of the project. Dr. Gueye expressed regret that no significant progress had been made since the 3rd Session of the Consultative Meeting on LMEs in June 2000. He stressed the need for action by the GEF Secretariat and FAO for the PDF-B funding support to be released so that implementation of the project can begin as soon as possible.

Barbara Cooney of FAO provided information on the approval process. Since the last consultative meeting the GEF Secretariat has provided comments on the PDF-B proposal. One of the suggestions was that greater emphasis should be put on the management of the fisheries resources. This suggestion was accepted by UNEP (the GEF implementing agency of the project), and FAO (the executing agency). The GEF Secretariat furthermore proposed that FAO might take over more responsibility for the project as the Executive Agency under the GEF expanded opportunities initiative. These suggestions were discussed by FAO and UNEP-GEF in March 2001, and UNEP-GEF indicated their agreement in principle with this approach. The PDF-B proposal was subsequently revised by FAO and re-submitted to UNEP and the GEF Secretariat. Follow-up

discussions have been held, and the GEF Secretariat is now waiting for UNEP-GEF to confirm in writing their agreement for FAO to take over responsibility for the implementation of the project.

2.4 GUINEA CURRENT LME

Drs. Piper and Sherman gave a summary of activities of the Guinea Current LME project. During the initial phase of the project in the Gulf of Guinea the six participating countries - Benin, Cameroon, Côte d'Ivoire, Ghana, Nigeria, and Togo - made significant movement toward a commitment to improve degraded coastal environment and restore the depleted fish stocks of the countries in the region. Among the successful accomplishments were published assessments of important coastal zone issues to be addressed, a region-wide mangrove restoration activity, joint fish surveys stock assessments, reductions in point source pollution, successful introduction of primary waste treatment, and a successful waste recycling system contributing to improved environmental conditions. Capacity-building strides were made with the training in a series of workshops, study groups, and meetings of a cadre of 900 co-operating LME marine specialists, production of a bilingual French-English outreach newsletter for the project, activation of several non-governmental organization (NGO) groups in project outreach actions, the planning and conduct of the first-ever completely African bottom trawl survey of the fish community of the Gulf of Guinea with joint participation by fishery scientists from each of the five participating countries on board a chartered fishing vessel. In keeping with the guidelines of the donor countries supporting the GEF, the Environmental Ministers of the participating countries made known their commitment to the principal objective of the project, namely the pursuit of economic development that ensures safeguards against any further environmental or resource degradation, and promotes long-term resource and ecosystem sustainability. The language used by the Ministers is in the form of an official statement known as the *Accra Declaration*. The second phase is now in the planning stage. The project will include participation of 10 more countries, Angola, Congo, Democratic Republic of the Congo, Gabon, Guinea-Bissau, Guinea, Equatorial Guinea, Liberia, Sao Tome and Principe, and Sierra Leone. The UNIDO will serve as the executing agency for the second phase. Initiation is contingent in final approvals by the UNEP and the UNDP expected to be completed in March 2002.

2.5 SOMALI CURRENT/AGULHAS CURRENT LMEs

The lead UN agency is the World Bank. Arrangements are underway to convene a planning meeting for sometime in spring 2002. Substantial government, private sector, and NGO support has been voiced for a region wide LME-based international approach for the fisheries resource of the Agulhas and Somali Currents. While the countries do not possess the sufficient financial and human resources to undertake the work necessary for such a project on their own, they have made clear that this is an important priority for them to pursue. The priority the countries give to this issue was made clear in PDF-A funded workshop under the "WIOF" project sponsored by the World Bank-GEF and held in Maputo, Mozambique, in 1999. The UNDP has held extensive consultations with governmental, private sector, university, and NGO individuals and groups in Madagascar, Mozambique and South Africa, as well as preliminary consultations with Comoros, Mauritius and Seychelles and has found substantial support for the overall objectives of a programmatic and ecosystem approach to these two LMEs. As Comoros, Mauritius and Seychelles were not involved in the World Bank's original workshop, discussions have been held with representatives of those countries and each has expressed an interest in participation. The more exact nature of their participation will be discussed and/or confirmed during the PDF-A workshop. The Implementing Agencies have also found that similar objectives are incorporated into the priorities of the relevant government ministries, the research agendas of universities, and NGO work programmes. It is expected that IUCN will play a lead role in the near-coastal activities.

2.6 SOUTH CHINA SEA LME

The project is being initiated with the UNEP serving as the executing agency. The project aims specifically at elaborating a SAP for the South China Sea including a cluster of related projects in the fields of marine biodiversity protection; protection of the South China Sea against degradation, particularly pollution from land-based activities; and management of multi-country freshwater drainage basins such as the Mekong and Hong-he (Red) Rivers that drain to the South China Sea. It will build upon the results of the TDA that prioritised the threats and problems identified in the project preparation (PDF-B) phase. Key issues are habitat degradation associated with mangrove loss and damage to coral reefs, over-exploitation of living resources, and pollution from sewage, industry and agriculture. Accelerated conversion of coastal areas to aquaculture/mariculture is also a large problem.

2.7 NORTH SEA LME

Professor McGlade provided the meeting with an expert review of recent LME trends in fisheries, socio-economics, governance, and ecosystem health using the North Sea as a model system. Among the more important observations are (i) the expected change in human population demographics, and (ii) declining fisheries biomass of table species. Approximately 164 million people use the coastline and marine environment of the North Sea catchment. Extra-European Community migration and migration between Member States are expected to add over 9 million to the total population of the northern seaboard by 2020. But given the decline in population growth rates, there will be a considerable shift towards the elderly age groups, leading to an increase in dependency rates, a fall in the labour force, increasing labour costs, with retirement migration becoming more important. To this end, exploitation patterns in the North Sea are likely to change significantly over the next 20 years.

The North Sea is a highly productive area supporting landings of about 2.5 million Metric tons (Mt) of fish and shellfish every year, plus an equivalent amount as food for predatory fish species and 0.75 million Mt as food for birds and mammals, from a total biomass of approximately 10 million Mt. This does not include the amount potentially eaten by birds and mammals in the Skagerrak/Kattegat and Channel. Landings for human consumption and industrial purposes are currently on average 1.6 million Mt and 1.75 million Mt, and are valued at 1,282 and 134 million Euros respectively. Whilst the North Sea ecosystem does not fluctuate wildly in terms of main species, it is not entirely stable with regard to individual species. Changes in the abundance of commercially important fish stocks in the North Sea have been monitored since the 1950s; all are heavily exploited and the majority of those landed for human consumption are considered to be in a seriously depleted condition, either outside Safe Biological Limits or below their Minimum Biologically Acceptable Level (i.e. a level of spawning stock size below which the stock may be in danger of severe depletion if it is not allowed to rebuild as quickly as possible). Results from surveys also suggest that there has been a change in the size composition of North Sea fish, with the quantity of larger fish declining and the numbers of small fish increasing. The International Council carries out analytical assessments of all commercially important species for the Exploration of the Seas. The results are used to establish a system of total allowable catches (TACs), and from their national catch quotas, which are the main instruments for attempting to control fishing mortality rates. About 40 fish and crustacean stocks are managed by quotas: in the European Union analytical TACs are set for stock where scientific knowledge is of sufficient quality as to be able to support the prediction of the next year's stock size. Precautionary TACs are set where knowledge is insufficient; in these cases the levels are set according to past catches so as to curtail unregulated expansion.

The TAC system has generally suffered from problems of enforcement, and as such there is a general recognition that it has failed to control fishing mortality in most North Sea fisheries. This is because without sufficient direct controls on the amount of fishing effort, fish can be caught in excess of the TAC and either discarded or landed illegally. Thus in reality, even though there are no discrepancies between the advice from ICES for TACs, the agreed TAC and the reported amount of fish landed for many North Sea stocks, large differences do exist. The result is that not only are the high levels of fishing mortality lowering the long-term yield, but also the quality and reliability of data have deteriorated, causing further problems in formulating advice. Professor McGlade also provided the Committee with a briefing on the general "health" of the North Sea Ecosystem, based on a set of six attributes applied in an innovative methodology that promotes a basis for comparing LME health among two or more systems. Professor McGlade's health assessment methodology is reproduced with her permission in Annex III.

2.8 ECOSYSTEM-BASED ASSESSMENTS

Hein Rune Skjoldal addressed briefly the general issue of spatial scale in ecosystem-based assessments. He indicated that marine ecosystems are dynamic, with climatic variability as a major driving force coupled with biological interactions. On the continuum from very small to large scale, the LMEs are positioned between the global and local/inshore scales. The climatic variability and change should be assessed at the global or large regional scale, but its biological effects on fish stocks are most conveniently assessed at the LME scale. A number of issues should be addressed at the local inshore scale, but there is clear need to periodically assess their integrated and combined effects at the scale of the LME, of which the coastal areas form a part. There is a growing appreciation that assessments of living marine resources for fisheries management purpose, environmental assessments for environmental management purpose, and description and prediction of Ocean State for operational maritime services, have a large common denominator in terms of data need, tools and products. This forms a strong incentive to move towards ecosystem monitoring and assessment as a joint venture between the fisheries, environmental, and meteorological science communities.

There is a close relationship between oceanography and fish stocks. Fish stocks have a requirement to have a geographical or spatial closure of the life cycle. Larval drift and spread from spawning to nursery areas and migration by juveniles and adults to feeding areas and back to their spawning areas are components in the spatial closure. This closure relates to the patterns of ocean currents and flow fields to which the fish stocks have been evolutionary and ecologically adapted. This provides a general mechanism to explain the high sensitivity of fish stocks to ocean climate variability and the high degree of co-variability among different stocks even if they are geographically separated. This also provides an important scientific rational for the practical definition of LMEs. The distinct bathymetry and flow fields provide for the existence of a number of commercial fish stocks being contained and trophically linked within the boundaries of a defined LME.

Skjoldal informed the Committee of recent developments concerning management of the North Sea. At an Intermediate Ministerial Meeting on the Integration of Fisheries and Environmental Issues in March 1997 in Bergen, Norway, the ministers agreed to develop and apply an ecosystem approach to the management of the North Sea. A workshop on the Ecosystem Approach to the Management and Protection of the North Sea held in June 1998 in Oslo, Norway elaborated a general framework for an ecosystem approach. This framework contains the following elements:

- Ecological and operational objectives
- Monitoring and research
- Resource and environmental assessments

- Scientific advice
- Policy decisions and management actions.

With regard to ecological objectives, there has been ongoing work within the OSPAR Commission to develop Ecological Quality Objectives (EcoQOs). A Workshop on Ecological Quality Objectives (EcoQOs) for the North Sea was held in September 1999 in Scheveningen, the Netherlands. Ten broad issues or compartments of the North Sea ecosystem were identified as the basis for the further elaboration of EcoQOs. The Netherlands and Norway have subsequently elaborated proposals for specific EcoQOs in 2001 by ICES and OSPAR. The Fifth International Conference on the Protection of the North Sea will be held 20-21 March 2002 in Bergen, Norway. At this conference it is the aim to have the implementation of an ecosystem approach to the management of the North Sea adopted by environmental ministers. The set of proposed EcoQOs will also be considered at this conference. The International Council for the Exploration of the Sea (ICES) and IOC have jointly established an ICES/IOC Steering Group for GOOS (SGGOOS). The SGGOOS arranged a strategic workshop in September 2001 in Bergen, Norway, on the development of a North Sea ecosystem component of GOOS for assessment and management. One of the recommendations from this workshop was to carry out a pilot project on oceanography and fish stocks in the North Sea. An ICES/EuroGOOS Planning Group has been established to plan and implement such a pilot project. This planning group will meet in February 2002 in Bergen, Norway.

2.9 NORTH ATLANTIC LME

Human activities and climatic changes have altered the enormous productive capacity of North Atlantic LMEs. In the northern margins of the Atlantic, LMEs are at risk from over-fishing, pollution, and habitat degradation. They are of considerable economic importance to consumer populations in major urban centres around the North Atlantic. Reported changes include the initiation of population recoveries among several of the groundfish stocks of the US Northeast Shelf LME; the collapse of Newfoundland-Labrador LME cod and subsequent increases in shrimp and crab populations; and the influence of oceanographic and food-web dynamics on the biomass yields of the Scotia Shelf, West Greenland Shelf, Iceland Shelf, and Faeroe Plateau LMEs. Case studies describing these changes are included in a new volume on the Large Marine Ecosystems of the North Atlantic to be released by Elsevier Science in April 2002.

2.10 BALTIC SEA LME

Dr. Thulin reported on the Baltic Sea LME project. He indicated that considerable activity has been underway since 2000 for advancing toward a fully implemented Baltic Sea LME project. The World Bank and the GEF approved the Project Implementation Plan (PIP) in late 2001 and the project is to introduce ecosystem-based assessment and management practices to the countries of the Baltic Sea region. The project is to be supported with funds from the GEF and western Baltic countries (Denmark, Finland, Germany, and Sweden). The recipient countries include Estonia, Latvia, Lithuania, Poland, and Russia. Three leading institutions operating in the region will participate in the project: ICES will provide scientific expertise and management for the ecosystem component of the project; the International Baltic Sea Fisheries Commission (IBSFC) will contribute fish stock assessments to the project; and the Helsinki Commission (HELCOM) with support activities to reduce pollution-induced stress on the Baltic ecosystem. Dr. Jan Thulin is serving as the Project Co-ordinator on behalf of ICES.

2.11 BAY OF BENGAL LME

At present, FAO is in the process of selecting a Principal International Expert to guide the preparation of the TDA and the SAP for the “sustainable management of the Bay of Bengal LME

project". Support for the project is high among the participating members of the Bay of Bengal Programme (BOBP). The BOBP countries have recognized the need to manage the coastal and near-shore areas in a co-ordinated, comprehensive, and integrated manner. The Advisory Committee of the Bay of Bengal Programme at its 19th meeting (Jakarta, January 1995) urged BOBP to prepare a proposal and explore GEF as a possible funding source. The Committee subsequently endorsed the recommendation for the Development and Management of Fisheries in the Bay of Bengal (BOBC), which functions as the policy-level committee of the BOBP. The BOBP member countries at the 20th Meeting of the Advisory Committee endorsed the concept paper in 1996. Participating countries include Bangladesh, India, Indonesia, Malaysia, the Maldives, Myanmar, Sri Lanka, and Thailand.

2.12 GULF OF MEXICO/PACIFIC CENTRAL AMERICAN/CARIBBEAN LMEs

Drs. Lluch-Belda and K. Sherman gave a brief summary of the planning documents for these three LME projects. The three projects are in the early planning phase. The Gulf of Mexico project has been approved for Block B funding to support TDA and SAP planning actions by, Cuba, Mexico, and the US. The other two proposals are to be submitted in mid to late 2002 to the GEF. The Caribbean project has the endorsement of IOCARIBE. Efforts are underway by UNIDO, NOAA, and IUCN to assist the countries bordering on the Pacific Central American Coastal LME in project preparation.

3. OTHER ACTIVITIES

3.1 THE HUMAN DIMENSION OF LMEs
(SOCIOECONOMICS AND GOVERNANCE MODULES)

Dr. Sherman gave a brief description on the outcome of socio-economics and governance workshops convened by the University of Rhode Island departments of Natural Resources Economics and Marine Affairs. A selection of papers given will be peer-reviewed and published in the new Elsevier LME series. Recently completed reports are listed in Annex VII.

3.2 LMEs AND GLOBAL OCEAN OBSERVING SYSTEM (GOOS)

Dr. Ned Cyr and Dr. Colin Summerhayes provided brief presentations on progress in the Global Ocean Observing System (GOOS) and the relationship of EuroGOOS and the Living Marine Resources Module of GOOS (LMR-GOOS) to LME activities across the globe. The LMR-GOOS panel has advocated an ecosystem approach to marine resources conservation and management. The panel has recently published a design plan for the Living Marine Resources component of GOOS, which is available on the GOOS web page at http://ioc.unesco.org/goos. Much of the information identified as necessary for implementing the Living Marine Resources component of GOOS was critical to support ecosystem-based management (e.g., productivity and fish surveys). These concepts are now being incorporated into a newly developing integrated design plan for GOOS in coastal seas, which should be published in mid-2002 by the Coastal Ocean Observations Panel for GOOS (COOP), which incorporates the former Living Marine Resources panel of GOOS. COOP covers all aspects of coastal seas including monitoring of the physical environment, the living marine resources, and the chemical (water quality) aspects. The COOP design plan will be a blueprint for the establishment of monitoring systems in coastal seas worldwide. Establishment of GOOS by IOC Members States therefore ought to provide a useful platform or tool for the implementation of LME assessments. In addition, the development of regional LME monitoring and assessment projects, such as the Guinea Current LME, Yellow Sea LME, Humboldt Current LME, Baltic Sea LME, and others, provides an excellent opportunity to support development of

GOOS in developing countries. Recognizing the mutual complementarity between GOOS and the LMEs, the committee recommended that GOOS should work closely with the LME Programme, and vice versa, to ensure the complementarity of regional efforts.

3.3 LMEs AND THE OFFICE OF NAVAL RESEARCH

Dr. Reginald Beach, Dr. John Harding, and Mr. Bob Bullard discussed the collaborative efforts between the LME Programme and operational products from the US Navy. The four factors used to partition the worlds coastal regions into 64 LMEs are bathymetry, hydrography, productivity, and trophic linkages. Global ocean nowcasts and forecasts developed at NRL are now operational or near operational at NAVO. Overviews of these specific capabilities were provided. Follow-on discussion focused on the possibility to "cookie-cut" global ocean nowcast/forecast products into regions corresponding to the LMEs. Identification of which products have most interest to the LMEs/Regional GOOS scientists and users is ongoing. This hydrographic forecast sharing policy is meant to engender international research collaboration, including the increased sharing of regional observations and the evaluation and feedback by regional experts. A list of high priority physical oceanographic products will be drawn up by the ICES Advisory Committee on Ecosystems and passed along to ONR for their consideration as candidate LME products.

3.4 UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Dr. David Piper provided the Committee with a profile of the contributions made by the United Nations Industrial Development Organization while serving as Executing Agency on behalf of the GEF and the UNDP for the first phase of the Gulf of Guinea LME project. Much of the success of the project was in the excellent organisational support provided by the UNIDO organization to the project co-ordinator, Dr. Chide Ibe. The strategic goal of the UNIDO is to pursue sustainable industrial development in developing countries and economies in transition through the creation of competitive economy, productive employment, and environmental protection, the so-called "Three Es." About two thirds of the world's economic activities are concentrated in coastal areas and therefore their ecosystems are over-stressed and become fragile. A significant portion of these activities is of industrial nature generated by manufacturing, environmental and service industries. UNIDO has the professional engineering staff and operational capability to address the needs of administering Large Marine Ecosystem projects. UNIDO's experience gained as an Executing Agency of the pilot phase of the GEF/UNDP financed Gulf of Guinea LME Project has prepared the Agency to support future GEF/LME projects in Asia, Africa, and Latin America.

3.5 LME MAP: SECOND EDITION

CDR Peter Celone of NOAA provided a description of the LME accession process in effect since 1984. An initial global map of 49 distinct LMEs was reviewed. Boundaries were based on four ecological criteria: bathymetry, hydrography, productivity, and trophic relationships. The map was reviewed and approved during the first IOC advisory meeting on LMEs (22-23 March 1991). This action was followed by the acceptance of the Pacific Central American Coastal (PCAC) LME following the publication of the study designating the PCAC in the volume *The Large Marine Ecosystems of the Pacific Rim*, edited by K. Sherman and Q. Tang (1995). The most recent designations of 14 Arctic and Australian LMEs was the outcome of a series of consultations with Russian, Norwegian, Canadian, and Australian marine ecology experts conducted over the past 18 months and by CDR Celone, Dr. Sherman, Dr. Reginald Watson, and Dr. Daniel Pauly of the University of British Columbia. The outcome of these deliberations was presented to the Consultative Committee by CDR Celone and deemed as an acceptable second edition projection of the LMEs of the world. Accompanying GIS-based bathymetry, hydrography, trophic web indices,

fish species abundance trends, chlorophyll, and primary productivity data for the newly designated LMEs was entered into the University of British Columbia and University of Rhode Island websites (www.data.fisheries.ubc.ca and www.edc.uri.edu/lme) and is presently accessible along with the second edition *Map of Large Marine Ecosystem of the World* (Figure 1). The 2nd edition LME map is compatible with the Longhurst biogeochemical global marine biomes and provinces. A multi-authored report describing the hierarchical integration of LMEs and the Longhurst BGCPs is in preparation (Watson et al. in press).

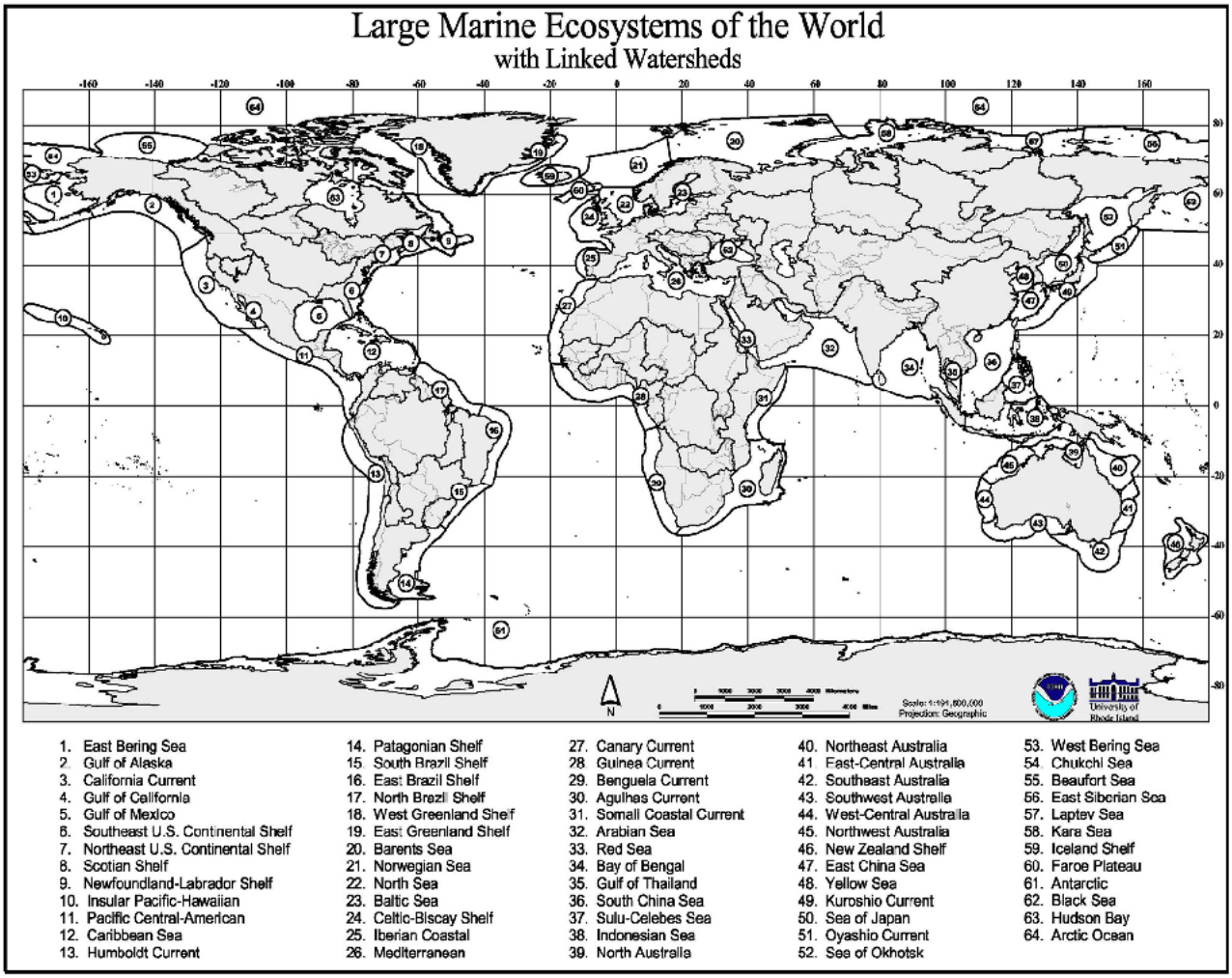

Figure 1. Large Marine Ecosystems are areas of the ocean characterised by distinct bathymetry, hydrography, productivity, and trophic interactions. They annually produce 95 percent of the world's fish catch. They are national and regional focal areas of a global effort to reduce the degradation of linked watersheds, marine resources, and coastal environments from pollution, habitat loss, and over-fishing. (www.edc.uri.edu/lme)

3.6 MARINE PROTECTED AREAS (MPAs)

The 3rd LME Advisory Group recommended that work be undertaken by IUCN on the relationship between LMEs and Marine Protected Areas (MPAs). Carl Lundin, IUCN Marine Co-ordinator, noted that work was ongoing on the use of protected areas at an ecosystem scale for fisheries management, and that a workshop on the subject had been organized by the IUCN and the NOAA at the International Coral Reef Symposium, held in Bali, Indonesia, in October 2000. It was suggested that the five LME modules provided an appropriate analytical framework for the establishment of a network of MPAs within an ecosystem, covering a full range of management

objectives. This included management measures for productivity, socio-economic benefits, and governance (e.g., conflict mitigation through transboundary protected areas), as well as biological diversity. Under the analytical framework of an LME, MPAs can provide not only representative samples of habitats, but protection for ecological processes (e.g., recruitment of species; maintenance of hydrological cycles). The Committee encouraged Carl Lundin to continue with further development of the MPA strategy as a means to enhance recovery of depleted biodiversity and marine fish populations.

3.7 NITROGEN

Dr. Sybil Seitzinger representing IOC on nitrogen, biogeochemical cycling and model projections of N for the year 2050 gave a presentation to the Committee. Dr. Seitzinger indicated that humans have dramatically altered the earth's nitrogen, phosphorus, and silica cycles resulting in considerable environmental degradation. For example, nitrogen inputs to terrestrial ecosystems have more than doubled since pre-industrial times due to the fixation of N2 gas into synthetic fertilisers and to the combustion of fossil fuels. A portion of this excess N applied/deposited in terrestrial ecosystems enters rivers and is transported to downstream coastal ecosystems. As a result coastal ecosystems worldwide are receiving increased nutrient inputs originating from human activities in their watersheds and airsheds. This nutrient enrichment in coastal ecosystems contributes to numerous environmental problems including increased algal growth, alteration and loss of seagrass habitats, increase in extent and duration of anoxic and hypoxic water, harmful algal blooms, and coral reef degradation, among other effects. In addition, nutrient enrichment is also increasing the anthropogenic emissions of nitrous oxide, a trace gas in the atmosphere that contributes to global warming and to the destruction of stratospheric ozone.

Nutrient inputs to coastal ecosystems are not evenly distributed globally, as shown by Dr. Seitzinger and her colleagues' spatially explicit N modelling work. The uneven spatial pattern observed is the result of the global distribution of human population, and the activities associated with the production and consumption of food to feed those people and to support their energy needs.

The human population is predicted to increase markedly over the next 50 years in certain world regions, notably China, India, Southeast Asia and possibly Africa. Industrialisation also is predicted to increase in many of these same world regions. Growing food to feed the expanding world population will required increased use of nitrogen and phosphorus fertilisers. Increased industrialisation, with the associated combustion of fossil fuels and NOx production, will result in increased atmospheric deposition of N. Both of these will undoubtedly lead to increased export of N and P to coastal ecosystems with resulting water quality degradation. For example, inorganic N export to coastal systems is predicted to increase 3-fold by the year 2050 from Africa and South America. Substantial increases are predicted for Europe (primarily from Eastern Europe) and N. America. Alarmingly large absolute increases are predicted for eastern and southern Asia; almost half of the total global increased N export is predicted for those regions alone.

There are a number of international implications of the predicted increases in population and industrialisation. First of all, where will the food be grown to feed the large population increases expected in Asia? Most analyses conclude that a portion of that food will be grown outside of Asia (e.g., North America); thus the environmental effects (e.g., coastal eutrophication, high nitrate concentrations in drinking water) of producing that portion of the food to feed Asia will be transferred to those regions as well. Increased industrialisation also has international implications (beyond the production of CO_2), because it results in increased NOy in the atmosphere that can be transported long distances and subsequently deposited outside the country of origin, again transferring the environmental effects across international boundaries. The current known and

potential future impacts of increased nutrient mobilisation on human and ecosystem health and environmental quality warrants further development of spatially explicit global models to forecast the export of N, P and Si to coastal ecosystems as a function of land-use and human activities in watersheds. UNESCO/IOC is uniquely positioned to be the home base for this activity, with Sybil Seitzinger providing the scientific leadership for the project.

3.8 THE GLOBAL ENVIRONMENT FACILITY

On behalf of Dr. Al Duda, the GEF Secretariat, Washington DC, Dr. Sherman presented a description of GEF-LME Project activities.

Before the 1992 Earth Summit in Brazil, the Global Environment Facility (GEF) was established within the World Bank as a pilot programme to test new approaches and innovative ways to respond to global environmental challenges in four focal areas: climate change, biodiversity conservation, ozone depletion, and international waters. In March 1994, after 18 months of intergovernmental negotiations, agreement was reached in Geneva to transform the GEF from its pilot phase into a permanent financial mechanism. The restructured facility, which has so far committed more than $2.5 billion in grant funding, is open to universal participation (currently 165 countries) and builds upon the partnership between the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank - which are its implementing agencies. In addition to the four focal areas, activities to address land degradation are also eligible for funding insofar as they relate to one or more of the four focal areas.

According to its Operational Strategy, the GEF will fund projects and programmes that are country-driven and based on national priorities designed to support sustainable development. In the international water area, GEF's objective is to contribute primarily as a catalyst to the implementation of a more comprehensive, ecosystem-based approach to managing international waters and their drainage basins as a means of achieving global environmental benefits. The GEF implementing agencies assist countries to find means of collaborating with neighbouring countries in international water projects. The GEF addresses priority transboundary concerns consistent with Chapters 17 and 18 of Agenda 21 made at the 1992 Earth Summit. Scientists and natural resource managers from 69 countries representing environmental and fisheries ministries recognise the usefulness of LME geographic designation as an ecologically based assessment and management unit for coastal and marine resources, and have developed or are in the process of developing proposals for implementing LME projects under the Operational Strategy of the Global Environment Facility. GEF support has already been provided to assist 52 recipient countries in addressing transboundary problems of LMEs that they share. A combined $165 million of GEF, donor, and national funding has been committed during the past 24 months in support of science-driven ecosystem-based management of four LMEs (South China Sea, Yellow Sea, Benguela Current, and the Baltic Sea).

With the initiation in 2001 of the Benguela Current, Yellow Sea, Baltic Sea, and Guinea Current Large Marine Ecosystem (LME) projects, 30 countries across the globe in Asia, Africa, and eastern Europe have made ministerial level commitments to ecosystem-based assessment and management practices in support of the global objectives of Chapter 17 of Agenda 21.

Among the specific project objectives are:

(i) the recovery of depleted fish biomass and fisheries to promote greater food security, sustainable productivity and socio-economic benefits;

(ii) the reduction in pollution and eutrophication levels of coastal waters;

(iii) the restoration of degraded habitats including corals, mangroves, and wetlands.

The biomass recovery and restoration activities encompass whole marine ecosystems from the drainage basin to the outer boundaries of coastal currents. An additional 20 countries are preparing proposals to improve global coastal health and restore depleted biomass yields in West Africa (Canary Current LME), East Africa (Somali Current and Agulhas Current LMEs), Asia (Bay of Bengal LME), and Latin America (Caribbean LME and Gulf of Mexico LME, Humboldt Current LME, and the Pacific Central American Coastal LME).

The GEF requires that "country-driven" LME projects include the preparation of a Transboundary Diagnostic Analysis (TDA) and Strategic Action Plan (SAP) to guide participating countries in carrying forward assessment and management action focused on the productivity, fish and fisheries, pollution and ecosystem health, socio-economics, and governance of shared ecosystems.

Examples of multi-ministerial level commitments for improving the biomass yields, health, and habitats of LMEs can be found in the *Accra Declaration* signed in 1998 by six African States (Benin, Cameroon, Côte d'Ivoire, Ghana, Nigeria, and Togo), the Benguela Current Commission organized in 2001 (Angola, Namibia, and South Africa), the participating countries in the GEF supported Yellow Sea LME project (China and Korea), and the Baltic Sea project recipient countries (Estonia, Latvia, Lithuania, Poland, and Russia). Other ecosystem-based projects are presently under consideration by several countries. Support for these activities is provided with a commitment over the next 5 years of $165 million in GEF, national, and donor funding. It is expected that, as other countries participate in the programme, the level of support will reach $200 million during the next GEF granting period.

From this growing LME activity a paradigm is emerging that is moving forward monitoring and assessment and management practices from single species to multi-species, from small spatial scales to larger spatial scales, from short-term management perspectives to long-term perspectives, and from managing single commodities to sustaining the production potential for a wider array of marine ecosystem goods and services. A paper describing the paradigm as a new international water imperative was presented at the Rio + 10 meeting convened by IOC in December 2001. An expanded abstract of the paper is included as Annex IV.

3.9 LME PROGRAMME OFFICE REPORT

3.9.1 Project Development

During 2001, the LME Programme Office continued to provide scientific and technical advice and assistance for project development in collaboration with representatives from developing countries and IUCN, IOC, UNIDO, UNDP, UNEP, FAO, and GEF. Among the high priority LMEs designated for country-driven project initiation were the Humboldt Current, the Pacific Central American Coastal, the Caribbean Sea, and the Patagonian Shelf in Latin America; the Baltic in eastern Europe; the Guinea Current, Canary Current, and Benguela Current in west Africa; the Agulhas Current and Somali Current in east Africa; and the Gulf of Mexico in North America. The Office continued to work with coastal countries in Asia to advance the Yellow Sea and Bay of Bengal projects from the TDA planning phases to the implementation of the action plans.

3.9.2 Biomass Yields and Catch Statistics

Activities to advance ecological studies within the LMEs are continuing. Among the challenges are refinements to the application of ecological criteria leading to a better understanding of the carrying capacity of LMEs in relation to fishery biomass yields. The LME Programme

Office is continuing collaboration with Dr. Pauly and his colleagues at the UBC Fisheries Centre on three scientific activities: (i) food web based energetic models to each of the LMEs; (ii) developing and implementing a methodology for assigning annual FAO global catch statistics to each of the 64 LMEs; and (iii) participating in the development of a global hierarchical geographic construct to accommodate the Longhurst biogeochemical global ocean areas and the LMEs into a compatible biogeographical zonation structure that will focus on LMEs as principal units for global resource and environmental assessment and management actions.

3.9.3 Newly Designated LMEs

Based in part on information provided in several working group meetings on LMEs in Australia attended by a representative of the Programme Office, the Australian Government has announced and the Committee concurs with the designation of five new LME boundaries, which extend along the Australian coast, with an offshore extension ranging from 100 to 200 miles offshore, and modification of two existing LMEs. In a peer-reviewed paper for the volume on "Global Perspectives of LMEs" to be published by Elsevier Press, Drs. Werner Ekau and Bastiaan Knoppers have proposed the designation of three LMEs for the coast of Brazil, in place of the present two. The Committee concurred with the new information presented in the paper, and accordingly, the LME Programme Office in Narragansett has redefined the coastal areas and boundaries into the North Brazil Shelf, the East Brazil, and the South Brazil Shelf LMEs, replacing the Northeast Brazil Shelf and Brazil Current LMEs. In the same volume, Drs. Daniel Pauly and Ratana Chuenpagdee propose, on the basis of recent data and analyses, the Gulf of Thailand as a distinct LME, a designation with which the Programme Office concurs. Additionally, Commander Peter Celone has been collaborating with experts at the Russian Academy of Sciences and Norway's Institute for Marine Research to define boundaries for 5 Arctic LMEs. The Arctic Ocean and Hudson Bay LMEs complete recent mapping activities. Following presentations on the results of the recent boundary definitions of the newly designated LMEs, the Committee approved production of a new edition of the world LME map. Prepared for the meeting by the Environmental Development Centre at the University of Rhode Island, coordinates for each of the 64 LMEs are in GIS format and can be found on the LME website (http://www.edc.uri.edu/lme/).

3.9.4 Global International Waters Assessment (GIWA)

The GIWA Programme Office continues efforts to assist the UNEP and the University of Kalmar, Sweden teams in carrying forward the assessment, based largely on LMEs as the principal assessment units. Dr. Dag Daler provided highlights of ongoing GIWA activities at the Committee meeting including a description of the methodology for Scaling and Scoping and Causal Chain Analysis. Dr. Daler described the successful general assembly held in Kalmar in October 2001.

3.9.5 Outreach

Activities will continue with the IOC and the IUCN in an outreach campaign to a network of over 2,900 LME contacts in Asia, Africa, North America, Latin America, and Europe. Brochures describing the modular approach for assessment and management of LMEs will be distributed prior to the upcoming World Summit on Sustainable Development (WSSD), scheduled for Johannesburg, in September 2002.

3.9.6 Meetings and Workshops

Attendance at meetings, consultations, workshops, and symposia were continued as a useful means for exchanging views and planning projects on the application of the LME approach to resource assessment and management actions. Advisory Committee members participated in

workshops on the Baltic Sea LME in Sweden and Copenhagen; a workshop with senior representatives from Chile and Peru on the Humboldt Current LME; Steering Committee meetings of the GIWA in Sweden; and Steering Committee meetings in Beijing and Seoul for the Yellow Sea LME project. Additional advisory actions included planning meetings for LME projects in Mexico for the Gulf of Mexico project, in Senegal for the Canary Current project, in Mozambique for the Agulhas Current project, in Ghana for the Guinea Current project, in India for the Bay of Bengal project, and in Costa Rica for the Pacific Central American Coastal project. Consultations were held at the UN in New York with the UNIDO and with the IOC and the IUCN at the UNESCO headquarters, Paris, at the 4th Annual LME Consultative Committee Meeting. Plans were developed with the IUCN and the IOC for convening a symposium in Monaco in 2003 to review the results of LME global activities since the UNCED Oceans Declarations of 1992.

For the Human Dimensions component of LMEs, NOAA and the IUCN at the Alton Jones Campus of the University of Rhode Island supported a major workshop with participation from academic, industry, and NGO communities. This meeting served as the basis for an LME volume to be published by Elsevier Press. Development continued for improving indices for (i) the changing states, (ii) socio-economic valuations, and (iii) governance of LMEs with senior staff at the University of Rhode Island and Woods Hole Oceanographic Institute. In collaboration with the IUCN, consultations were undertaken to examine the approach to ecosystem-based resource assessment and management of Polar LMEs with representatives from Canada, Norway, Russia, and US.

3.9.7 LME Website Work and Volume Preparations

The website for LMEs continues to serve as a means for describing assessment and management of coastal ecosystems around the globe. Information is provided on modular actions including productivity, fish and fisheries, pollution and ecosystem health, socio-economics, and governance issues. The website also serves to connect users with regionally based programmes, and provides links to governmental and NGO information relevant to each LME project. The LME website was updated with the assistance of Dr. Peter August and Christopher Damon of the University of Rhode Island. They continued working with CDR. Peter Celone to update and produce a second edition of the World map of the Large Marine Ecosystems. A periodic review and update of LME activities will be posted on the website and emailed to 600 addresses. Advancement of the Internet Map Server development continues with collection and assembly of data layers (temperature, salinity, chlorophyll, and primary productivity estimates) for a well-studied LME (Northeast US Continental Shelf) as well as a less studied LME (Guinea Current).

Peer-reviewed papers from existing and future LME volumes (e.g., North Atlantic, Global Trends, and Gulf of Guinea) continue to be synthesised and added to the site. Links to other sites, whose contents are consistent with the goals of the LME strategy, have been added; specifically the UBC Fisheries Centre fish catch statistics site. The Programme Office is also collaborating with the ONR to deliver operational products specifically tailored for each LME.

Editorial work continues on three LME volumes. The volume, “Changing States of the Large Marine Ecosystems of the North Atlantic”, co-edited with Hein Rune Skjoldal, was submitted to Elsevier for publication and is scheduled for release in April 2002. Gotthilf Hempel is making good progress with his volume, “Large Marine Ecosystems of the World: Trends in Exploitation, Protection and Research”, and Professor Jacqueline McGlade will be submitting her volume on “The Gulf of Guinea” to Elsevier for publication in early spring 2002.

4. ACTIONS AND RECOMMENDATIONS

1. **The Committee**, in response to a generous offer by ONR to provide ocean products at the LME scale, **requested** from ICES a list of priority oceanographic products that would best characterise the oceanographic features of an LME.

2. **The Committee recommended** that work be continued by IUCN on the relationships between LMEs and MPAs.

3. Considering the successful planning and implementation of LME projects by 60 countries with $200 million from the GEF, donor, and national countries**, the Committee recommended** that a conference of participants be convened during 2003 in either a North American or European venue to review progress and exchange information on lessons learned from project activities. The principal participants in the conference would be those marine specialists representing each project country, from Africa, Asia, Latin America, and Eastern Europe.

4. The Committee took cognisance of gaps in international waters strategy in the three key ecosystem activity areas: (i) fishing and food webs, (ii) nitrogen increases within LMEs, and (iii) need for greater transparency in the preparation of TDAs and SAPs. The recent reporting in Science and Nature of the major underreporting of global annual marine fish catches, by as much as 10 million Mt, underscores the importance of cross-validation of estimates and assessments of changing states of the world's LME. A UBC type modelling analysis that would provide estimates of trophic accounting and carrying capacity in relation to fisheries yields would provide a means for validating catch levels from each of the World's LMEs. Another global issue that will have a negative impact on the world's LME is the growing problem of coastal eutrophication. In a recent model analysis, Seitzinger and her colleagues estimated that the influx of Nitrogen to LMEs by the year 2050 would triple the present already high levels and create serious threats from emerging marine diseases for humans, and marine finfish, shellfish, and mammals. The greater frequency and extent of harmful algal blooms will result in mass mortalities of marine species from biotoxins and oxygen depletion events. Coincident with these problems, is the need to build greater capacity among the developing countries for mitigating against growing degradation of coastal waters and marine population, through training in assessment and management practices based on a fast track multi-sectoral ecosystem-based movement toward long-term marine resource sustainability. One of the actions proposed to address this issue is a 6-week intensive training programme for candidates from developing countries in ecosystem-based TDA and SAP methodologies, using the five modules LME approach with emphasis on socio-economic and governance assessment practices. **The Committee recommended** that a mid-size GEF project be developed to address these three "gaps" in international waters.

5. **The Committee recommended** that the LME Programme Office encourage pertinent UN agencies to expedite the planning and implementation process for LME projects with a special effort being directed to the UNEP/GEF co-ordinating unit in Nairobi.

6. Recognizing the importance of recent activities leading to the WSSD, **the Committee decided** to annex several pertinent documents to this report; (i) A New Imperative For Improving Management of Large Marine Ecosystems, the extended abstract written by A. Duda and K. Sherman presented at the Rio +10 meeting in Paris, France, in December, 2001 (Annex IV), (ii) a report summary from the Rio +10 meeting prepared by A. Vallega (Annex V), and (iii) LME products currently available on the University of Rhode Island, University of British Columbia, and the Office of Naval Research websites (Annex VI) .

7. Considering the growing number of developing countries participating in LME projects in conformity with the GEF guidelines for adopting more aggressive recovery and sustainability policies and actions, **the Committee recommended** that a brochure describing the country-driven commitments toward LME sustainability be prepared for distribution to the marine community prior to the WSSD scheduled for Johannesburg in September 2002.

8. Recognizing the potential for complementarity between LME assessment and management modules and components of GOOS observation strategy, **the Committee recommended** that when practicable, LME project managers and coordinators develop scientific liaisons with regional GOOS programmes for purposes of conducting mutually useful exchanges of oceanographic information.

9. Considering the importance of the Canary Current Large Marine Ecosystem to the food security of bordering coastal countries, **the Committee recommended** that actions be undertaken by FAO, UNEP, and the GEF to expedite the initiation of the Block-B phase of the project.

ANNEX I

AGENDA

IOC/IUCN/NOAA LME Consultative Meeting
UNESCO/IOC
Paris France
8-9 January 2002
Co-Chairs: P. Bernal/K. Sherman
Tuesday, 8 January

TIME	TOPIC	LEADER
0900	Greetings IOC	P. Bernal
	Update on LME Activity	K. Sherman/C. Lundin
	GEF, Operational Strategy: TDA, SAP processes	A. Duda*
	Benguela LME Update	M. O'Toole
	UNIDO – Perspective	C. Ibe
	Yellow Sea LME Update	Q. Tang
1230	*Lunch*	
1400	GIWA	D. Dahler
	GOOS/LMEs	C. Summerhayes/N. Cyr/ J. Ahanhanzo/R. Beach
	Canary Current LME Update	M. Gueye/B. Cooney
	Guinea Current LME Update	C. Ibe
	Somali Current LME/Agulhas Current LME Update	C. Lundin
	South China Sea LME – Bohai Sea Update	K. Sherman
	Socio-economics-Governance Perspective/North Sea LME/EU	J. McGlade
	Regional Scale of Ocean Governance	A. Vallega*
1800	Adjourn	

* Background paper

Wednesday, 9 January

TIME	TOPIC	LEADER
0900	North Atlantic LMEs	H.R. Skjoldal
	Polar LMEs/POPs/ LME Map Update/www Update	G. Matishov/R. Piper/ P. Celone
	Baltic LME/ICES Update	J. Thulin
	Bay of Bengal LME Update	M. O'Toole
	Gulf of Mexico/Pacific Central American/Caribbean	D.L. Belda
	Marine Protected Areas	C. Lundin
	Eutrophication	S. Seitzinger
1230	*Lunch*	
1400	Human Dimensions/Biomass Restoration	K. Sherman
	LME Round Table Review and Planning Session 2002-2003	Committee
1700	Adjourn	

ANNEX II

LIST OF PARTICIPANTS

Ellik Adler
United Nations Environment Programme
UNEP, Room T-236, PO Box 30552
Nairobi, KENYA
Tel: 254 2 624033
Fax: 254 2 624618
E-mail : ellik.adler@unep.org

Justin Ahanhanzo
IOC/UNESCO
1 rue Miollis, Paris Cedex 15, FRANCE
Tel: 33 145 68 36 41
Fax: 33 145 68 58 12
E-Mail: j.ahanhanzo@unesco.org

Reginald Beach
Associate Director for Ocean, Atmosphere and Space
US Office of Naval Research - Europe
223 Old Marylebone Road,
London NW1 5TH, UK
US Post: ONR IFO, PSC 802 Box 39, FPO AE 09499-0039
Tel: +44 (0)207 514 4964
Fax: +44 (0)207 723 6359
E-Mail: rbeach@onrifo.navy.mil

Patricio Bernal
Executive Secretary
IOC/UNESCO
1 rue Miollis, Paris, Cedex 15, FRANCE
Tel: 33 1 45 68 38 83
Fax: 33 1 45 68 58 12
E-Mail: p.bernal@unesco.org

Peter Celone
USDOC/NOAA/NMFS
28 Tarzwell Drive
Narragansett, RI 02882-1199
USA
Tel: (401) 782-3288
Fax: (401) 782-3201
E-Mail: peter.j.celone@noaa.gov

Barbara Cooney
FAO-TCI
Viale delle Terme di Caracalla
00100, Rome, ITALY
Tel: 39 06 5705 5478
Fax: 39 06 5705 4657
E-Mail: Barbara.Cooney@fao.org

Ned Cyr
USDOC/NOAA/NMFS Headquarters
Bldg: SSMC3, Rm. 12555
1315 East-West Highway
Silver Spring, MD 20910-3282
USA
Tel: (301) 713-2363 ext. 159
Fax: (301) 713-1875
E-Mail: Ned.Cyr@noaa.gov

Dag Daler
GIWA
SE-391 82 Kalmar
SWEDEN
Tel: +46-(0)480 44 73 51
Fax: +46-(0)70 544 60 46
E-Mail: dag.daler@giwa.net

Ndiaga Gueye
Directeur de l'Océanographie
et des Pêches maritimes
1 rue Joris
BP. 289 Dakar
SENEGAL
Tel: 221 821 6578
Fax: 221 821 4758
E-Mail: ngueye@sonatel.senet.net

Daniel Lluch-Belda
Depto. De Pesquerias, CICIMAR
Centro Interdisciplinario de Ciencias Marinas, IPN
Av IPN s/n, Col Palo de Sta Rita
Ap Postal 592
La Paz, BCS 23096, MEXICO
E-Mail: dlluch@ipn.mx

Carl Gustaf Lundin
Head, Marine Programmes
IUCN - The World Conservation Union
Rue Mauverney 28
1196 Gland, SWITZERLAND
Tel: 41-22-999-0001
E-mail: cgl@iucn.org

Gennady G. Matishov
Director
Murmansk Marine Biological Institute (MMBI)
Russian Academy of Sciences
17, Vladimirskaya St.
Murmansk, 183010
RUSSIAN FEDERATION
Tel: +7 (8152) 56-52-35
Fax: 47-789-10-288
E-mail: mmbi@online.ru

Jacqueline McGlade
10 The Coach House
Compton Verney
Warwickshire
CV35 9HJ, UNITED KINGDOM
Tel: 44 1926 642259/44 2076 792297
Fax: 44 1926 642575
E-Mail: jacquie.mcglade@ucl.ac.uk

Mick O'Toole
Bay of Bengal LME Programme
91, St. Mary's Road
Abhirampuram
Chennai
600 018
Tamil Nadu, INDIA
Tel: 00-91-44-4936387 (direct)
Tel: 00-91-44-4936118
Fax: 00-91-44-4936102
E-Mail: boblme@vsnl.net

Mick O'Toole at home
c/o Church Road, Kinvara, Co. Galway
IRELAND
Tel: 353 91 637358
Fax: 353 91 637706
E-Mail: mick.otoole@ireland.com

David Piper
UNIDO
Vienna International Centre
P.O. Box 300, Room D 1218
A-1400 Vienna, AUSTRIA
Tel: 431-26026 3883
E-Mail: d.piper@unido.org

Hein Rune Skjoldal
Institute of Marine Research
P.O. Box 1870
Mordnesparkon 2
Bergen, NORWAY, 5024
Tel: 47-55-24-25-22
E-Mail: hein.rune.skjoldal@imr.no

Sybil Seitzinger
Intergovernmental Oceanographic Commission
UNESCO
1, Rue Miollis,
75732, Paris cedex 15, FRANCE
Tel: (33)(0)1 45 68 3986
Fax: (33)(0)1 45 68 58 12
E-Mail: s.seitzinger@unesco.org

Rodolfo Serra
Instituto de Fomento Pesquero, IFOP
Casilla 8-V,
Valparaiso, CHILE
Tel: 56-32 217817/212630
Fax: 56-32 213178
E-Mail: rserra@ifop.cl

Kenneth Sherman
USDOC/NOAA National Marine Fisheries Service
Narragansett Laboratory
28 Tarzwell Drive
Narragansett, Rhode Island, 02882, USA
Tel: 401 782 3211
Fax: 401 782 3201
E-Mail: Kenneth.Sherman@noaa.gov

Colin Summerhayes
Director, Global Ocean Observing System (GOOS) Project Office
IOC/UNESCO
1, Rue Miollis,
75732, Paris cedex 15, FRANCE
Tel: (33)(0) 1 45 68 40 42
Fax: (33)(0) 1 45 68 58 13 (or 12)
E-Mail: c.summerhayes@unesco.org

Qisheng Tang
Yellow Sea Fisheries Research Institute,
106 Nanjing Road, Quigdao, 266071
CHINA
Tel: 0086 532 583 6200
Fax: 0086 532 581 1514
E-Mail: ysfri@public.qd.sd.cn

Jan Thulin
ICES
Palaegade 2-4
1261 Copenhagen K
Denmark
Tel: +45-33 154225
Fax: +45 33 934215
E-Mail: jan.thulin@fiskeriverket.se

Ole Vestergaard (Technical Secretary)
IOC/UNESCO,
l rue Miollis,
75732, Paris Cedex 15, FRANCE
Cedex 15
Tel: 33 145 68 40 68
Fax: 33 145 68 58 12
E-Mail: o.vestergaard@unesco.org

Umit Unluata
Head, Ocean Science Section
IOC/UNESCO
1 rue Miollis,
75732, Paris cedex 15, FRANCE
Tel: (33-1) 45 68 40 08
Fax: (33-1) 45 68 58 12
E-Mail: u.unluata@unesco.org

ANNEX III

GENERAL ASSESSMENT OF THE NORTH SEA ECOSYSTEM

An excerpt from Chapter 12 of the forthcoming volume, "Changing States of the Large Marine Ecosystems in the North Atlantic" to be published in April 2002 by Elsevier Science

By Professor Jacqueline McGlade

In the absence of long-term data series and detailed statistics, comparative analyses are often the only basis upon which the status of an ecosystem can be evaluated. Various approaches are available, but key to them all is the need to identify the inter-linkages existing between features (natural and social), activities and processes and the effects of these through time on the dynamics of the ecosystem, as well as the outputs, or goods and services, that it provides.

For this assessment of the health of the North Sea ecosystem, two principle criteria have been used: socio-economic performance and ecosystem health. To properly undertake the assessment, management objectives, system complexity and forms of governance have been examined. A set of attributes have been selected: for ecosystem health, biodiversity, level of pollution and trophic stability are used; for socio-economic performance, sectoral outputs of good and services, cohesion and institutional strength/governance are used. Each attribute may have more than one measure associated with it. The time periods chosen were pre-1957 and 1958-present, to coincide with the Treaty of Rome, the establishment of the European Commission and the extension of industrial activities in the North Sea.

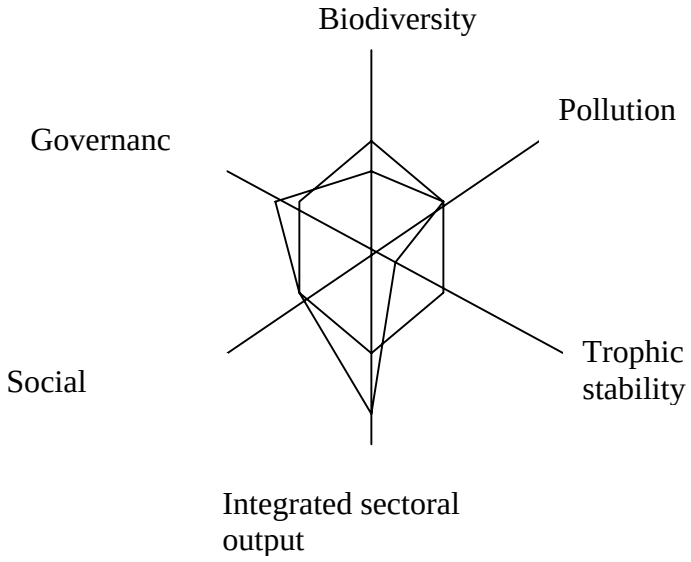

Figure 12-2. Kite diagram to indicate changes in the North Sea Large Marine Ecosystem, with pre-1957 values set to zero.

To enable numeric and non-numeric attributes with different numeraires to be compared, observations are placed in fuzzy classes (i.e. small, medium, large; positive or negative) depending on the extent of the information available. The value for each measure lies within the range -5 to +5, with pre-1957 values set at zero. A value for each attribute for the post-1957 period is obtained by combining different measure values of each measure into one distribution and obtaining the

mean with a central weight function. The resulting values of this de-fuzzification are then placed into a kite diagram to indicate the changes that have occurred. Wherever possible the evaluation has been undertaken for the entire North Sea (Figure 12-2; Table 12-4).

As the combined results show, the ecological attributes indicate a general decline, and the socio-economic attributes a notable increase. In other words, the outputs derived from the ecosystem have been arrived at via some cost to the environment, albeit not commensurate on the scale used. This is unsurprising. However, the measures also suggest that: i) the changes observed in trophic structure are indicative of a trend towards decreasing resilience, ii) the trend is not only a response to fishing pressure and resource exploitation, but also to inter-annual changes in the physical oceanography of the North Atlantic, and iii) traditional economic measures of sectoral outputs (e.g. GNP) are not a true reflection of the true value of the North Sea ecosystem to the states involved. Rather, the measure reflecting social cohesion and institutional strengths are also of significance. Overall, despite several decades of increasing exploitation, the North Sea large marine ecosystem has provided and continues to provide a high level of goods and services to the human and biological communities that rely on it.

Table 12-4. Attributes for general ecosystem assessment.

Attribute	**Measure**
Biodiversity (all cited communities)	- 2
Pollution levels (Class I and II)	- 1
Trophic stability (abundance, size-classes and life-span)	- 3
Integrated sectoral outputs (fisheries, energy, tourism, transport)	+ 4
Social cohesion (conflicts; migration)	+ 1
Institutional strength (legal & political regimes)	+ 2

ANNEX IV

A NEW IMPERATIVE FOR IMPROVING MANAGEMENT OF LARGE MARINE ECOSYSTEMS

Extended abstract for working group 7 and panel 15
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By Alfred M. Duda[1] and Kenneth Sherman[2]

Continued over-fishing, destruction of habitats, and accelerated pollution loading have dramatically reduced biomass and diversity of the coastal oceans to the point that several ecosystems are collapsing, national economic benefits from the marine systems are falling, and communities depending on the resources for livelihoods and protein are being stressed. When mismanagement of freshwater resources is added to these concerns, along with new threats from fluctuating climatic regimes, it becomes clear that the global life support system is at risk placing the socio-economic future of coastal regions in jeopardy.

A NEW IMPERATIVE

These trends were identified in Stockholm 30 years ago, and their significance was reaffirmed with actions adopted at the UN Conference on Environment and Development (UNCED) in Rio in 1992 under Agenda 21. Commitments to an alternative pathway have been made by the world community in global instruments such as the UN Convention on the Law of the Sea (UNCLOS), the Convention on Biological Diversity (CBD), the Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities, and the UN Framework Convention on Climate Change (UNFCCC). However, progress in the last decade since Rio has been disappointing. Activities under Chapter 17 and Chapter 18 of Agenda 21 were conducted in isolation rather than linked to restore and protect coastal ecosystems. Initiatives under the different legal instruments were thematic, fragmented, or disconnected with sound science and consequently were unable to influence political decisions. Competing programs developed over time, and those driven by the donor community were just not comprehensive or participative enough to capture the commitment of developing nations.

At the end of the last century, a new common understanding emerged about the deepening degradation of coastal and marine ecosystems—that the decline is not just a problem of developing nations but is also driven by over-consumption from developed nations. Indeed, rich countries now acknowledge the need to adopt many reforms as well, not only for their degraded marine waters but also to provide a safety net to conserve marine waters of developing nations that are exploited for global commerce.

As a new century dawns, a new imperative exists for a radical shift in thinking about how marine ecosystems are to be managed. North-South collaboration must result in changes in the economic sectors that create the stress on our valuable marine ecosystems. If the spiralling degradation of coastal and marine ecosystems is to be reversed so that these ecosystems continue to provide both livelihood benefits to coastal communities and foreign exchange to governments, a more ecosystem-based approach needs to be implemented. The fragmentation and competition

[1] GEF Secretariat, 1818 H Street N.W., Room G-6015, Washington, DC 20433, USA
[2] USDOC/NOAA/NMFS, Northeast Fisheries Science Center, Narragansett Laboratory, 28 Tarzwell Drive, Narragansett, RI 02882, USA

characteristic of activities under Chapter 17 must be overcome and stakeholders must be harnessed as a force for reform in the economic sectors creating the stress on marine ecosystems.

GEF SUPPORT TO COUNTRY-DRIVEN IMPLEMENTATION OF CHAPTER 17

Developing country officials responsible for coastal and marine resources have understood the ramifications of the declining trends in their natural resources. Across Africa, Asia and the Pacific, Latin America and the Caribbean, and in Eastern Europe, country officials have been experimenting through assistance from the Global Environment Facility (GEF) with strategies for reversing the decline of their marine ecosystems, restoring once abundant biomass for sustaining growing populations of coastal communities, and conserving highly fluctuating systems to ensure continued benefits for future generations. Since the early 1990s, these nations have approached the GEF and its implementing agencies (the UN Development Programme, UN Environment Programme, and World Bank) and executing agencies like the UN Industrial Development Organization, for assistance in its international waters focal area to restore and protect their coastal and marine ecosystems.

The GEF Operational Strategy provides guidance on addressing these issues within the framework of sustainable development. GEF recommends the use of Large Marine Ecosystems (LMEs) and their contributing freshwater basins, where appropriate, as the geographic area for integrating changes in sectoral economic activities. This place-based assistance with initial interventions through participative, multi-country processes of setting priorities and adopting commitment to action are helping countries make the transition to ecosystem-based management of these transboundary systems that encompass two or more coastal nations.

One of the two principal processes used to engage the science community in each of the participating countries for establishing ecosystem-based priorities for transboundary issues is the Transboundary Diagnostic Analysis-TDA. The other process, known as the Strategic Action Programme-SAP enables co-operating nations to jointly determine what policy/legal/institutional reforms and investments they need to make to address the TDA priorities. Once such country-driven commitments to actions are established, the GEF may also fund incremental costs of implementing the action programme or SAP to accelerate adoption of management regimes based on the concept of adaptive management for the LMEs as a whole rather than the management of specific sector by sector issues in isolation.

The five-module approach to LMEs (described below) that has proven useful in other settings is essentially customised to fit the situation within the context of the TDA process and the SAP process for particular groups of nations sharing an LME based on available information and capacity. These processes are critical to integrate science into management and this concept is being demonstrated in eight funded projects, four known as Comprehensive LME Demonstrations and to a lesser extent in four other LMEs based on country interests in certain transboundary issues. This demonstrates flexibility of the LME approach. For example, where GPA concerns prevail such as eutrophication in the Black Sea, a series of GEF projects for the basins (Danube) and the states of the Black Sea LME constituted an integrated approach to reduce nitrogen loading from the 17 contributing nations along with development of a fisheries convention for the 6 Black Sea states.

NEW MOMENTUM CREATED IN OVER 120 COUNTRIES

The 8 approved GEF-LME projects involve 60 developing nations or those in economic transition as well as another 17 OECD countries since the living resources, the pollution loading, or the critical habitats have transboundary implications. With the inclusion of the Western Pacific Warm Water Pool Ecosystem project funded by GEF for 14 Pacific SIDS, a total of 74 developing or

transitional countries are participating in the LME restoration effort. An additional 7 LME projects under preparation involve 76 nations (65 of them developing countries). This magnitude of country driven interests is at present overwhelming the GEF's limited resources as well as the priorities of its implementing agencies. This growing number of country-driven commitments to change as fostered by the GEF, and the global imperative to change because of the degraded condition of the global coastal oceans provides an unprecedented opportunity for accelerating the transition to the sustainable use, conservation, and development of coastal and marine ecosystems. The costs of inaction in supporting the fledgling efforts of over 120 countries trying to do their part in implementing Chapter 17 of Agenda 21 by focusing on LMEs are much too high. Momentum must not be lost because the result may be irreversible damage to coastal and marine ecosystems, the poor communities depending on them, and the economy of coastal nations.

FIVE MODULE LME APPROACH

Large Marine Ecosystems (LMEs) are regions of ocean space encompassing coastal areas from river basins and estuaries to the seaward boundaries of continental shelves and the outer margins of the major current systems. They are relatively large regions on the order of 200,000 km2 or greater, characterised by distinct: (1) bathymetry, (2) hydrography, (3) productivity, (4) and trophically dependent populations. On a global scale, 64 LMEs produce 95 percent of the world's annual marine fishery biomass yields. Within their waters, most of the global ocean pollution, overexploitation, and coastal habitat alteration occur. For 33 of the 50 LMEs, studies have been conducted of the principal driving forces affecting changes in biomass yields. They have been peer-reviewed and published in nine volumes.

The Ecological Society of America Committee on the Scientific Basis for Ecosystem Management concluded that the overarching principle for guiding ecosystem management is to ensure the intergenerational sustainability of ecosystem goods (e.g. fish, trees, petroleum) and ecosystem services or processes including productivity cycles and hydrological cycles. More recent reports add support to the principle expressed by the ESA Committee. From a fish and fisheries perspective, the National Research Council (U.S.) concludes that sustaining fishery yields will require sustaining the ecosystems that produce the fish. This approach represents a paradigm shift from the highly focused short-term sector-by-sector resource assessment and management approach in general practice today by natural resource stewardship agencies, to the broader more encompassing ecosystem approach that moves spatially from smaller to larger scales, and from short-term to longer-term management practice. Included in the new paradigm is a movement from the management of commodities to the sustainability of the productive potential for ecosystem goods and services.

This approach builds on an earlier application of "an ecosystem approach" to management of the Great Lakes Basin Ecosystem, and more recent efforts in developing an ecosystem assessment approach for the management of the North Sea, the Northeast Shelf of the U.S., the Gulf of Mexico, the Baltic Sea, and the Yellow Sea. The ecosystem approach recognises humankind and economic/social systems as being integral parts of the ecosystem. The Great Lakes approach led to agreements between the U.S. and Canada to follow longer-term pathways for sustainable use of ecological resources. The two decades of experience in struggling to operationalise this ecosystem approach has resulted in management programs to reverse the trend in coastal degradation.

Based on lessons learned from the LME case studies, a five-module strategy has been developed to provide science-based information for the monitoring, assessment, and management of LMEs. The modules are focused on LME: (1) productivity, (2) fish and fisheries, (3) pollution and health, (4) socio-economics, and (5) governance.

1. Productivity Module

Productivity can be related to the carrying capacity of an ecosystem for supporting fish resources. Recently, scientists have reported that the maximum global level of primary productivity for supporting the average annual world catch of fisheries has been reached, and further large-scale "unmanaged" increases in fisheries yields from marine ecosystems are likely to be at trophic levels below fish in the marine food chain. Evidence of this effect appears to be corroborated by recent changes in the species composition of the fisheries catches from the East China Sea LME. Measuring ecosystem productivity also can serve as a useful indication of the growing problem of coastal eutrophication. In several LMEs, excessive nutrient loading of coastal waters have been related to algal blooms implicated in mass mortalities of living resources, emergence of pathogens (e.g., cholera, vibrios, red tides, paralytic shellfish toxins), and explosive growth of non-indigenous species.

The ecosystem parameters measured in the productivity module are zooplankton biodiversity and information on species composition, zooplankton biomass, water column structure, photo-synthetically-active radiation (PAR), transparency, chlorophyll-a, NO2, NO3, and primary production. Plankton of LMEs has been measured by deploying Continuous Plankton Recorder (CPR) systems monthly across ecosystems from commercial vessels of opportunity over decadal time scales. Advanced plankton recorders can be fitted with sensors for temperature, salinity, chlorophyll, nitrate/nitrite, petroleum, hydrocarbons, light, bioluminescence, and primary productivity, providing the means to monitor changes in phytoplankton, zooplankton, primary productivity, species composition and dominance, and long-term changes in the physical and nutrient characteristics of the LME and in the biofeedback of plankton to the stress of environmental change.

2. Fish and fisheries module

Changes in biodiversity among the dominant species within fish communities of LMEs have resulted from: (1) excessive exploitation, (2) naturally occurring environmental shifts in climate regime, or (3) coastal pollution. Changes in the biodiversity of a fish community can generate cascading effects up the food chain to apex predators and down the food chain to plankton components of the ecosystem. These three sources of variability in fisheries yield are operable in most LMEs. They can be described as primary, secondary, and tertiary driving forces in fisheries yields, contingent on the ecosystem under investigation. For example, in the Humboldt Current, Benguela Current, and California Current LMEs, the primary driving force influencing variability in fisheries yield is the influence of changes in upwelling strength; fishing and pollution effects are secondary and tertiary effects on fisheries yields. In continental shelf LMEs, including the Yellow Sea and Northeast United States Shelf, excessive fisheries effort has caused large-scale declines in catch and changes in the biodiversity and dominance in the fish community. In these ecosystems, pollution and environmental perturbation are of secondary and tertiary influence. In contrast, significant coastal pollution and eutrophication have been the principal factors driving changes in fisheries yields of the Northwest Adriatic, Black Sea, and near-coastal areas of the Baltic Sea. Overexploitation and natural environmental changes are of secondary and tertiary importance. Consideration of the driving forces of change in biomass yield based on multi-year time-series data is important when developing options for management of living marine resources for long-term sustainability.

2. Fish and Fisheries module

The Fish and Fisheries module includes fisheries-independent bottom-trawl surveys and acoustic surveys for pelagic species to obtain time-series information about changes in fish biodiversity and

abundance levels. Standardised sampling procedures, when deployed from small-calibrated trawlers, can provide important information on diverse changes in fish species. Fish catch provides biological samples for stock assessments, stomach analyses, age, growth, fecundity, and size comparisons; data for clarifying and quantifying multi-species trophic relationships; and the collection of samples for monitoring coastal pollution. Samples of trawl-caught fish can be used to monitor pathological conditions that may be associated with coastal pollution. Trawlers also can be used as platforms for obtaining water, sediment, and benthic samples for monitoring harmful algal blooms, virus vectors of disease, eutrophication, anoxia, and changes in benthic communities.

3. Pollution and ecosystem health module

In several LMEs, pollution has been a principal driving force in changes of biomass yields. Assessing the changing status of pollution and health of the entire LME is scientifically challenging. Ecosystem "health" is a concept of wide interest for which a single precise scientific definition is problematical. Methods to assess the health of LMEs are being developed from modifications to a series of indicators and indices described by several investigators. The overriding objective is to monitor changes in health from an ecosystem perspective as a measure of the overall performance of a complex system. The health paradigm is based on multiple-state comparisons of ecosystem resilience and stability and is an evolving concept.

To be healthy and sustainable, an ecosystem must maintain its metabolic activity level and its internal structure and organization, and must resist external stress over time and space scales relevant to the ecosystem. Panels of experts at two NOAA workshops convened in 1992 discussed these concepts. Five of the indices discussed by the participants are being considered as experimental measures of changing ecosystem states and health: (1) biodiversity; (2) stability; (3) yields; (4) productivity; and (5) resilience. Data from which to derive the experimental indices are obtained from time-series monitoring of key ecosystem parameters. The ecosystem sampling strategy is focused on parameters relating to resources at risk of overexploitation, species protected by legislative authority (marine mammals), and other key biological and physical components at the lower end of the food chain (plankton, nutrients, and hydrography).

Fish, benthic invertebrates, and other biological indicator species are used in the Pollution and Ecosystem Health module to measure pollution effects on the ecosystem, including the bivalve monitoring strategy of "Mussel-Watch;" the patho-biological examination of fish; and the estuarine and near-shore monitoring of contaminants and contaminant effects in the water column, substrate, and in selected groups of organisms. The routes of bio-accumulation and trophic transfer of contaminants are assessed, and critical life history stages and selected food chain organisms are examined for parameters that indicate exposure to, and effects of, contaminants. Effects of impaired reproductive capacity, organ disease, and impaired growth from contaminants are measured. Assessments are made of contaminant impacts at the individual species and population levels. Implementation of protocols to assess the frequency and effect of harmful algal blooms, emergent diseases and multiple marine ecological disturbances are included in the pollution module.

4. Socio-economic module

This module is characterised by its emphasis on practical applications of its scientific findings in managing an LME and on the explicit integration of economic analysis with science-based assessments to assure that prospective management measures are cost-effective. Economists and policy analysts will need to work closely with ecologists and other scientists to identify and evaluate management options that are both scientifically credible and economically practical with regard to the use of ecosystem goods and services.

Designed to respond adaptively to enhanced scientific information, socio-economic considerations must be closely integrated with science. This component of the LME approach to marine resources management has recently been described as the human dimensions of LMEs. The Department of Environment and Natural Resource Economics have developed a framework at the University of Rhode Island for monitoring and assessment of the human dimensions of an LME and the socio-economic considerations important to the implementation of an adaptive management approach for an LME. One of the more critical considerations, a methodology for considering economic valuations of LME goods and services has been developed around the use of interaction matrices for describing the relationships between ecological state and the economic consequences of change.

5. Governance module

The Governance module is evolving based on demonstrations now underway among ecosystems to be managed from a more holistic perspective than generally practised in the past. In projects supported by GEF - for the Yellow Sea ecosystem, the Guinea Current LME, and the Benguela LME - agreements have been reached among the environmental ministers of the countries bordering these LMEs to enter into joint resource assessment and management activities. Among other LMEs, the Great Barrier Reef ecosystem is being managed from a holistic ecosystem perspective along with the Northwest Australian Continental Shelf ecosystem being managed by the state and federal governments of Australia. The Antarctic marine ecosystem is being managed from an ecosystem perspective under the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and its 21-nation membership. Movement toward ecosystem management is emerging for the North Sea, Barents Sea, Black Sea and Baltic Sea. In essence, the 5 modules and the TDA-SAP processes foster an adaptive management approach to joint governance based on iterative assessments of indicator parameters as part of establishing and reviewing progress in Monitoring and Evaluation indicators for GEF purposes. These processes help to integrate science into the management regime. Recent reports from the University of Rhode Island examine options for improving linkages between the science-based productivity, fish and fisheries, and pollution-ecosystem health modules and the socio-economic and governance modules, including the use of governance profiles.

LME Stress and Recovery

Results from LME case studies support the need for nations to adopt an ecosystem-based assessment and management approach to recover depleted biomass and sustain long-term yields of fisheries while conserving biodiversity. Three principal driving forces are described in 11 of the LME case studies as root causes of decadal changes in biodiversity dominance and biomass yields: (1) overfishing (U.S. Northeast Shelf, Yellow Sea, East China Sea, Iceland Shelf); (2) climate regime shifts (Humboldt Current, Benguela Current, Iberian Coastal, Guinea Current, Canary Current, California Current); and (3) pollution and eutrophication (Black Sea).

The LMEs are also under stress from land-based, riverine inputs of persistent organic pollutants and sewage, excessive loading of nitrogen from fertilisers and livestock associated with the "Green Revolution" as well as atmospheric deposition that have degraded a number of LMEs. Excessive inputs of N (500Gg/area/year) can markedly alter marine ecosystems causing increases in eutrophication, changes in trophic linkages, increases in hypoxia, emergence of pathogens, and mass mortalities of living resources. Increases in eutrophication and hypoxia, when coupled with habitat and nursery area loss pose a threat to the livelihoods of poor communities in developing nations and their access to inexpensive protein for survival.

Recent carefully controlled ecosystem-based management actions in two LMEs are serving to reverse multidecadal declines in biomass yields. Since 1994, reductions in fishing effort increased the spawning stock biomass (ssb) levels of cod on the Icelandic Shelf ecosystem, and haddock, yellowtail flounder, and other species in the U.S. Northeast Shelf ecosystem. The ssb of herring and mackerel in the Northeast Shelf ecosystem was increased from 600 000 Mt following U.S. quota limitations imposed in 1975 on foreign fishing effort to 3.5 million Mt in 1999. The quota limitations were implemented in both ecosystems before irreversible loss occurred.

Lessons For Sustaining Renewed Commitments

While many of the 16 country-driven LME initiatives supported with GEF grant funding have just started, and in others the national and regional reforms in progress will take several years to achieve, a number of lessons are becoming evident for the world community to consider in reversing the decline of its coastal oceans. As noted in the paper presented at this meeting, a geographic approach, based on the LMEs of the world and their linked coastal areas and freshwater contributing basins (where linkage is needed), is more appropriate than a thematic approach (e.g. fisheries, sewage, sediment, contaminants). In this manner, all the different stresses can be addressed jointly through integrated, collective processes and in integrated, collective national actions carried forward in the different economic sectors to deal with the priorities. Processes such as the TDA and SAP are needed to foster multi-stakeholder dialogue, inter-ministerial dialogue, and a discourse with the science community in unravelling complex situations so they can be divided into priority pieces for management. If everything environmental is a priority, little will get done---a focus on priorities is essential. The iterative assessment and management cycle fosters an adaptive management approach through establishment of indicators for the GEF that are periodically measured and are to be tracked over time by the nations as Monitoring and Evaluation indicators.

The LME geographic approach then allows all levels of institutions (multi-country, national inter-ministerial and local government/communities) to participate for buy-in and adoption of reforms; themes which are not place-based can not garner real commitments for change by stakeholders in economic sectors. The national inter-ministerial committee established in each country to operationalize and carry forward program actions is particularly important. This approach is far more effective than just the well-intentioned capacity building of environment ministries and isolated local, community-based approaches. The policy/ legal/institutional reforms and key investments are needed in the economic sectors if action is to be effective and sustained and institution-building supported by governments.

The multi-country institution and its regime for assessing and managing LMEs is also critical to address the priorities. Without such joint visions for reform and commitments to action, no ad hoc actions will be sustainable. This makes the socio-economic and governance modules critical to the decisions for reform so that the overfished stocks may recover, the wasted by-catch reduced, critical habitats conserved and joint management institutions developed. The processes of jointly producing a SAP ensure country-driveness and the availability of incremental cost-based grant finance can provide an incentive for countries to take that next steps. As shown by completed SAPs, programs of action and reforms are needed, not just one-off projects if reversing the decline is to be successful. Competing global programs, competing interests of donors, competing priorities of international finance institutions also should be reconsidered and harmonised so that they support in a co-ordinated and sequenced manner the reforms leveraged by these action programs and work in unison to support participating countries as they implement these difficult reforms.

Perhaps most importantly, the GEF-LME projects are illustrating that holistic, ecosystem-based approaches to managing LMEs are critical for providing a platform to focus on multiple benefits under multiple global instruments. Instead of establishing competing programs with

inefficiencies and duplication, which is the norm now, the LME projects foster action on priority transboundary issues ACROSS instruments in an holistic manner—across UNCLOS, the Jakarta Mandate of the CBD, the GPA and its pollution loading reductions, and in dealing with inevitable adaptation issues under UNFCCC. In fact, this ecosystem-based approach, centred around LMEs and participative processes for countries to undertake for building political commitment and inter-ministerial buy-in, is intended as the way ahead consistent with Chapter 17. The adaptive management framework resulting from iterative application of the GEF Operational Strategy allows for sequential capacity building, technology introduction, and investments to an ecosystem-based group of nations by the world community so that this collective response to global conventions and other instruments can be accomplished in a practical manner. The 5 modules ensure that management institutions are engaged with the science community in joint efforts developed in conjunction with stakeholders. In this way, ecological surprises of the future that will be generated by fluctuating climate can be more effectively handled by the joint institutions then at present, and will have a better chance to insulate from disasters the poor communities that are the first to suffer adverse effects of inadequate and inappropriate management efforts.

ANNEX V

SUMMARY REPORT OF RIO +10, PANEL 15

By A. Vallega

Global Conference on
OCEANS AND COASTS AT RIO+10.
Towards the 2002 World Summit on Sustainable Development
December 3-7, 2001
UNESCO, Paris

Assessing Progress, Addressing Continuing and New Challenges

Track 3
Regional Seas
Panel 15

The Regional Scale of Ocean Governance: Examining Key Ingredients for Success in Regional Co-operation

Chair Report

PANELLISTS

The Panel 15 includes the following panellists:

- Adalberto Vallega, Chair person and speaker
- Gunnar Kullenberg
- Jorge Illueca, replaced by Nelson Andrade
- Kenneth Sherman
- Alan Simcock
- Peter Stenlund
- Tumari'i Tutangata
- Miguel Fortes
- Zaitzev Viacheslov and André-Serge Mikuiza

KEY QUESTIONS AND CONTRIBUTIONS

The papers and contributions from panellists, and the subsequent discussion were focused on the following key questions:

1. What are the major problems to be dealt with, and need to be met;
2. What course correction is needed;
3. What major recommendations should be addressed to the WSSD.

The contributions and discussions led to the following evaluation and recommendation breakdown:

Major problems and needs	*Course correction*	*Major recommendations*
GUNNAR KULLENBERG		
A major need is to implement the approach to the ocean on the regional scale by including the goal of environmental security.	To be more sensitive to the concept of sustainable development of regional seas by considering its social component, in particular, security from military, health and ecological struggles.	In dealing with ocean management on the regional scale, to adopt the broad concept of sustainable development, as was adopted by UNCED, namely as promoting ecological integrity, economic efficiency and social equity.
ADALBERTO VALLEGA		
The political approach to the regional scale of ocean management has advanced to the point of requiring a more rational concept design of the ocean regions and ocean regionalisation.	A course re-orientation is needed leading to implementing the rationale of the regional approach to the ocean, to co-ordinating the wide range of present approaches, and to framing them in a broad global change concept, including climate change and globalisation.	A permanent forum on the regional scale of ocean management could be useful. It should design the optimum operational approach to ocean regionalisation.
JORGE ILLUECA, REPLACED BY NELSON ANDRADE		
The present conditions are marked by: (i) too many international environmental agreements; (ii) discrepancy between the vision of global conventions and the regional conventions and action plans; (iii) the constraints due to the fact that the regional sea programmes depend on governmental contributions to the Trust Fund; (iv) not all the regional sea programmes are well visible, and its importance is not well known.	A course re-orientation is needed including: (i) the implementation of synergies of the regional approach with global conventions; (ii) the strengthening of linkages between regional sea programmes and other agreements in order to optimise their action at the regional level; (iii) the involvement of the private sector in regional seas programmes in order to show to its problem-solving capacity to the public opinion.	These recommendations should be addressed: (i) to build up a strong partnership with major partners in the ocean field, particularly IMO, IOC, BASEL, MARPOL; (ii) to strengthen the capacity of the regional seas programmes to deal with environmental issues; (iii) to make the regional seas programmes visible to civil society; (iv) to join the regional seas programmes, conventions and M.E.As in order to optimise the whole output.
KENNETH SHERMAN		
A major problem is to ensure the sustainable management of coastal ecosystems.	A course re-orientation should consist in strengthening the role of GEF system in improving the management of Large Marine Ecosystems (LMEs) shared by neighbouring states.	Recommendations should include the adoption of the LME concept as the key tool to operate ecologically- and socially sound approaches to the regional scale of ocean management.

In addition to the following points, the panellists proposed the following recommendation to be adopted by the Conference and addressed to the WSSD. This proposal was shared by the participants in the panel:

"The Conference reviewed progress in the development of GEF supported prospects by 120 countries in Asia, Africa, Latin America and eastern Europe for introducing a regional ecosystems approach to recover depleted fish stocks and degraded habitats, so as to improve socio-economic benefits from the shared resources of large marine ecosystems. The GEF supported projects are fostering actions on priority transboundary issues responsive to the objectives of the CBD, GPA and the UNFCC.

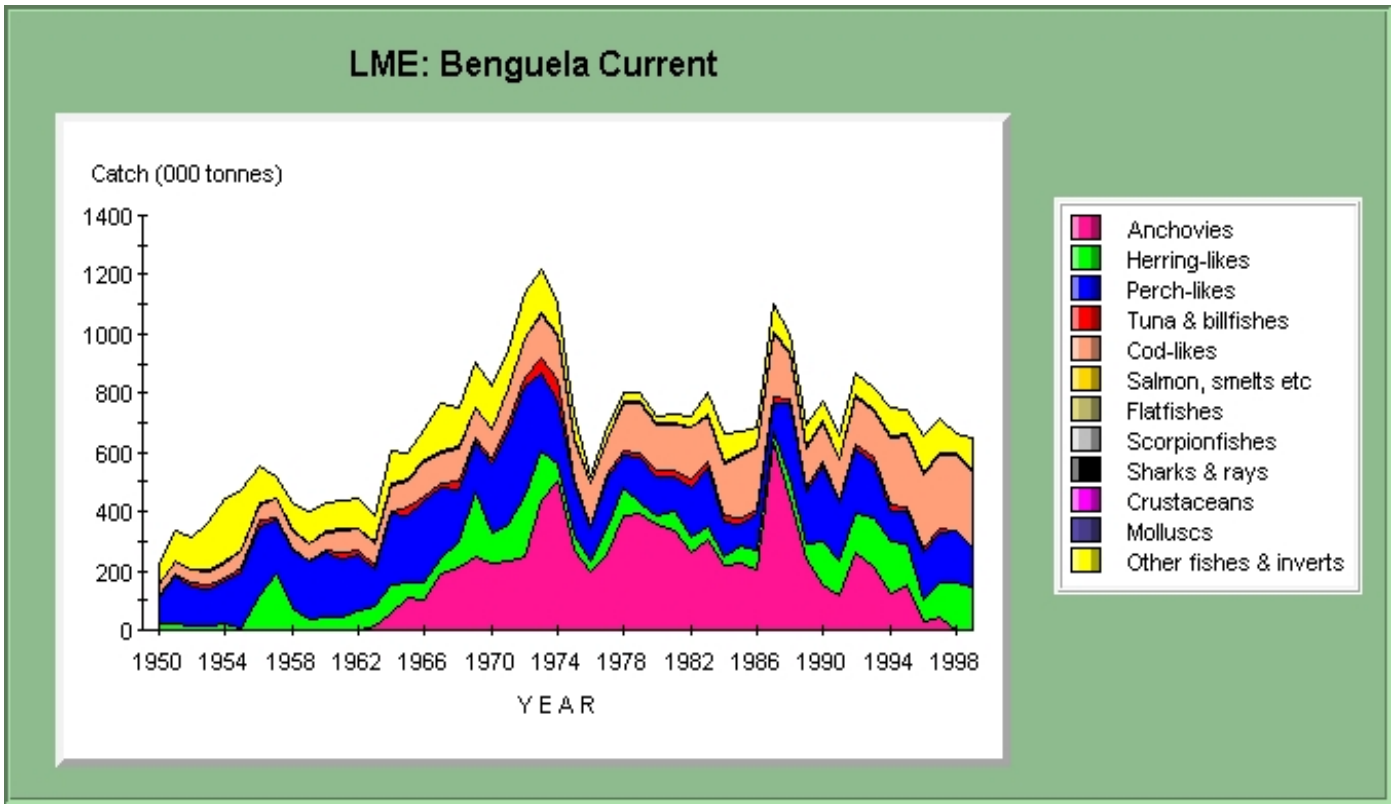
In recognition of the importance of an integrated regional approach to the assessment and management of coastal marine waters, the Conference recommends replenishment by donor countries and institutions of regional grants supporting the restoration and sustainability of degraded large marine ecosystems important to the food, health, and economic security of developing countries and countries in transition."

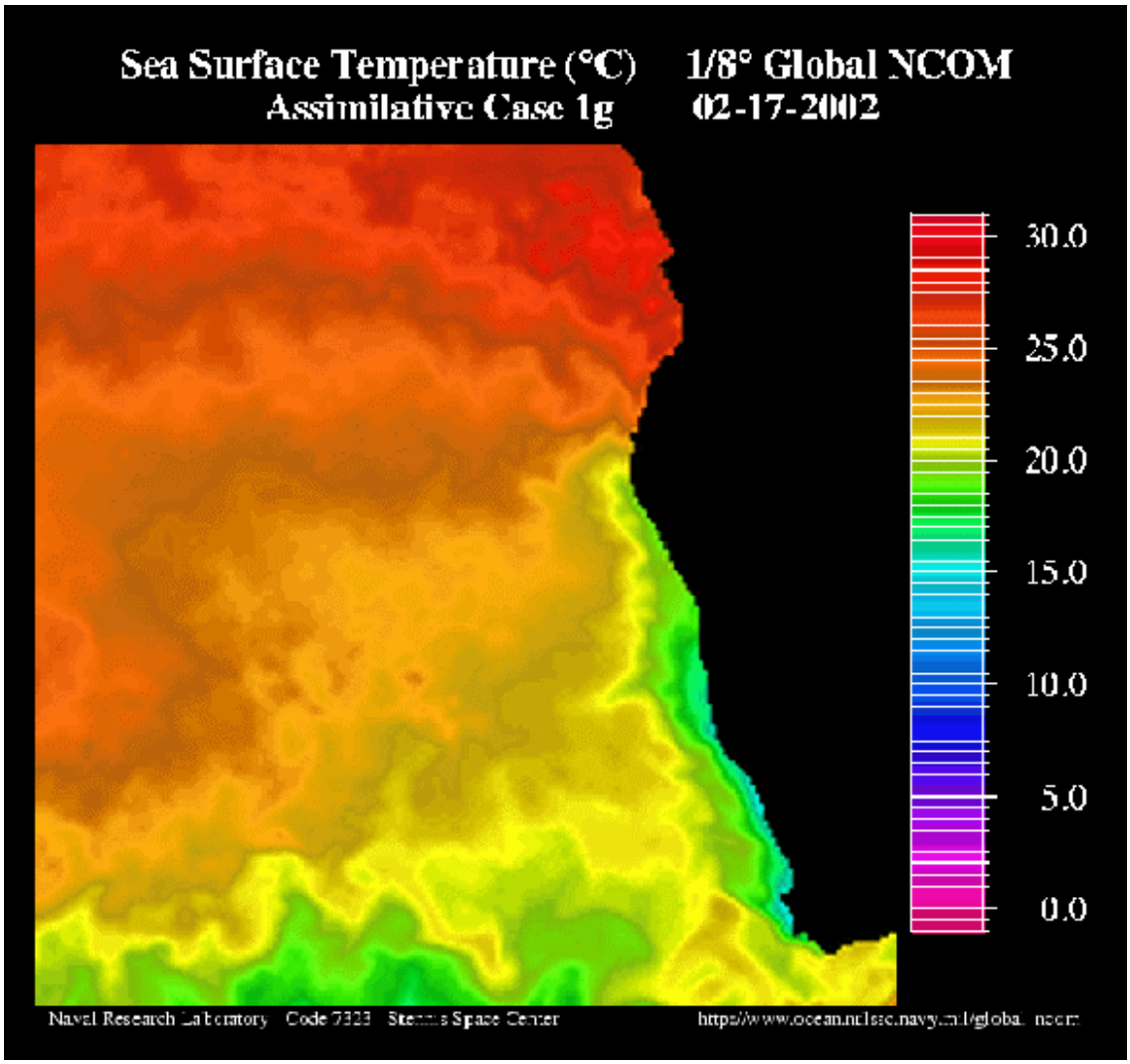
ALAN SIMCOCK		
A major need is to make the inter-state co-operation more effective vis-à-vis the environmental protection on the regional scale.	Moving from successful approaches, such as that carried out in the Northeastern Atlantic effectiveness of the environmental protection on the regional scale should improve.	The rationale and effectiveness of Agenda 21, Chapter 17 should be implemented with reference to the environmental protection of international and national waters on the regional scale.
PETER STENLUND		
A major need is to implement the assessment of the sub-polar and polar ocean areas, and the understanding of the relevant needs.	Lessons should be learned from the outcome of regional co-operation activated in the late 1990s.	Sub-polar and polar seas should be included in the agenda of ocean management on the regional scale.
TAMARI'I TUTANGATA		
The need to deal with island management by operating approaches on the regional scale has gained importance.	Moving from the successful experience carried out by the Council of Regional Organisations of the Pacific; a model of the regional approach to island management should be adopted.	It is recommended (i) to strive for improved efficiency in regional governance and improved cross-sectoral integration on the regional scale; (ii) emphasise regional before international agreements; (iii) to influence donor ethics; (iv) to focus on national and regional rather than international priorities.
MIGUEL FORTES		
The need to implement the approach to the management of seagrass- and mangrove-endowed areas has gained importance.	Research on seagrass- and mangrove-endowed areas should be become effectively management-oriented.	A specific initiative on the regional scale should be adopted in order to safeguard the ecological integrity of seagrass and mangrove areas in the Asian-Pacific context.

ZAITZEV VIACHESLOV AND ANDRE-SERGE MIKOUIZA Re: Caspian Sea		
The major problems include: (i) decrease of stocks of biological resources, such as sturgeon and kilka; (ii) increase of pollution caused by the oil and gas exploration and exploitation; (iii) invasion of ctenophore *Mnémiopsis leidyi.*	The course of implementation should include: (i) the strengthened role of intergovernmental and non-governmental organisations in the evaluation of the ecological conditions of the Caspian sea; (ii) the improvement of technologies, through efficient technology transfers.	Recommendations include: (i) providing assistance to the governmental organisations of the Caspian riparian countries in agreements and other legal actions; (ii) to design a regional convention dealing with the ecological issues and needs; (iii) to establish the Caspian Institute of Experts; (iv) to operate measures for combating the population explosion of the ctenophore *Mnémiopsis leidyi*.

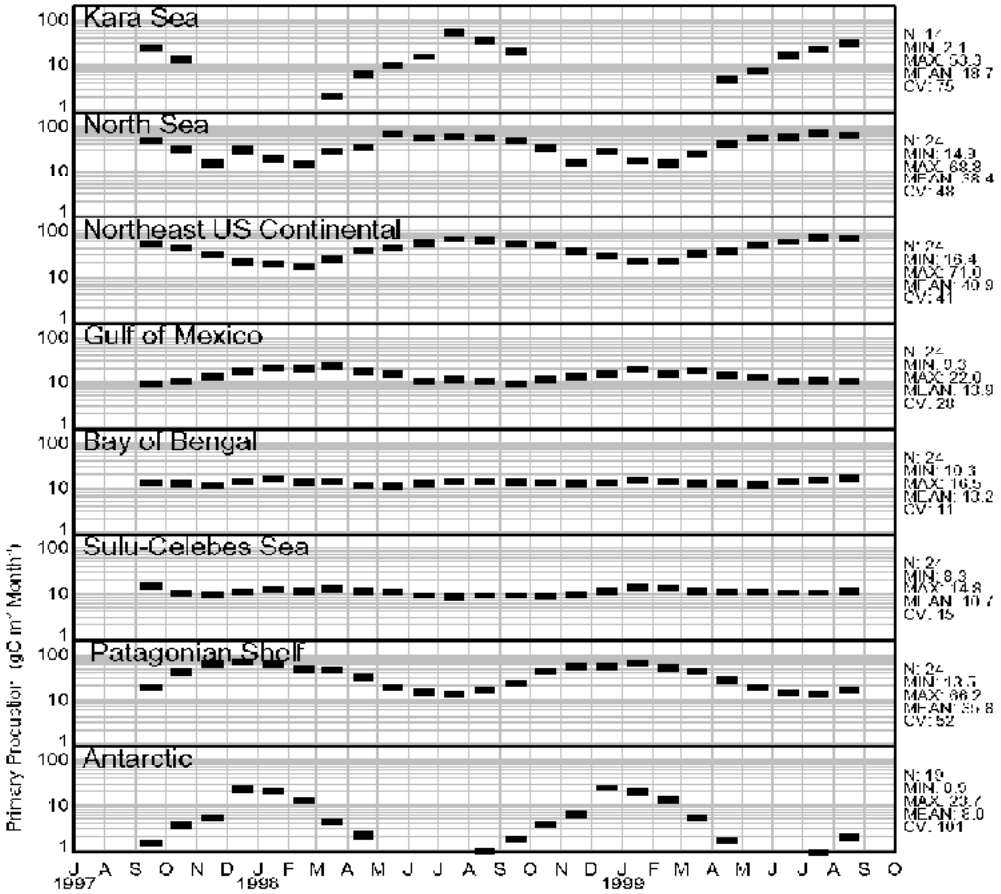
ANNEX VI

EXAMPLES OF LME WEBSITE PRODUCTS





An example of the Office of Naval Research/NRL Coastal Ocean Model Image Output for the Benguela Current LME.



An example of NOAA/NMFS Narragansett Laboratory Ocean Productivity Investigation of SeaWifs Primary Productivity (mean monthly gC/m^2).

ANNEX VII

RECENTLY COMPLETED REPORTS

On LME Socio-economics and Governance

Woods Hole Oceanographic Institute

1. Jin D, Hoagland P, Steele JH. *Linking Economic and Ecological Models for Large Marine Ecosystems*. Marine Policy Center, Woods Hole Oceanographic Institute. 1999. 16pp.

2. Jin D, Hoagland H. *Economic Activity Associated with the Northeast Shelf Large Marine Ecosystem: Application of an Input-Output Approach. Marine Policy Center*, Woods Hole Oceanographic Institute. 1999. 37pp.

University of Rhode Island

1. Juda L, Hennessey T. Governance Profiles and the Management of the Uses of Large Marine Ecosystems. *Ocean Development and International Law*. 2001;32:43-69.

2. Sutinen et al. *A Framework for Monitoring and Assessing Socio-economics and Governance of Large Marine Ecosystems*. NOAA 2000. 32pp. (Technical Memorandum NMFS-NE-158).

3. Juda L. Consideration in Developing a Functional Approach to the Governance of Large Marine Ecosystems. *Ocean Development and International Law*. 1999; 30:89-125.

ANNEX VIII

LIST OF ACRONYMS

ACC SOCA	U.N. Administrative Committee on Coordination's Subcommittee on Oceans and Coastal Areas
BCC	Benguela Current Commission
BCLME	Benguela Current Large Marine Ecosystem
BOBP	Bay of Bengal Programme
FAO	Food and Agriculture Organization (UN)
GEF	Global Environment Facility
GIS	Geographic Information System
GIWA	Global International Waters Assessment
GLOBEC	Global Ocean Ecosystems Dynamic
GOOS	Global Ocean Observing System (IOC-WMO-UNEP-ICSU)
HELCOM	Helsinki Commission
IBCC	Interim Benguela Current Commission
IBSFC	International Baltic Sea Fisheries Commission
ICES	International Council for the Exploration of the Sea
IOC	Intergovernmental Oceanographic Commission (UNESCO)
IUCN	World Conservation Union
LME	Large Marine Ecosystem
LMR	Living Marine Resources Module
MPA	Marine Protected Areas
NAVO	Naval Oceanographic Office, US
NGO	Non-governmental Organization
NOAA-NMFS	National Oceanographic and Atmospheric Administrations; National Marine Fisheries Service
NRL	Naval Research Laboratory
ONR	Office of Naval Research, US
OSPAR Com.	The Oslo and Paris Commission (for the Protection of the Marine Environment of the North-East Atlantic)
PCU	Programme Coordinating Unit
PIP	Project Implementation Plan
SAP	Strategic Action Programme
TDA	Transboundary Diagnostic Analysis
UBC	University of British Columbia
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
WSSD	World Summit on Sustainable Development, Johannesburg, South Africa, 2002
YSLME	Yellow Sea Large Marine Ecosystem

In this Series, entitled

Reports of Meetings of Experts and Equivalent Bodies, which was initiated in 1984 and which is published in English only, unless otherwise specified, the reports of the following meetings have already been issued:

1. Third Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
2. Fourth Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans S. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' ***(Also printed in Spanish)***
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IODE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
11. First Session of the IOC Consultative Group on Ocean Mapping ***(Also printed in French and Spanish)***
12. Joint 100-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
13. Second Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
14. Third Session of the Group of Experts on Format Development
15. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
16. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
17. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and lntercalibration
18. Second Session of the IOC Group of Experts on Effects of Pollutants
19. Primera Reunión del Comité Editorial de la COI para la Carta Batimétrica lnternacional del Mar Caribe y Parte del Océano Pacífico frente a Centroamérica ***(Spanish only)***
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
21. Twelfth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
22. Second Session of the IODE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
24. Second Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources ***(Also printed in French and Spanish)***
25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and lntercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans ***(Also printed in French)***
28. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
30. First Session of the IOCARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities ***(Also printed in Spanish)***
31. Second IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
32. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asia Tectonics and Resources
33. Second Session of the IOC Task Team on the Global Sea-Level Observing System
34. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
35. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
36. First Consultative Meeting on RNODCs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSS-IODE Data Flow
38. Fourth Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
39. Fourth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
40. Fourteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
41. Third Session of the IOC Consultative Group on Ocean Mapping
42. Sixth Session of the Joint IOC-WMO-CCPS Working Group on the Investigations of 'El Niño' (***Also printed in Spanish)***
43. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
44. Third Session of the IOC-UN(OALOS) Guiding Group of Experts on the Programme of Ocean Science in Relation to Non-Living Resources
45. Ninth Session of the IOC-UNEP Group of Experts on Methods, Standards and lntercalibration
46. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
47. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
48. Twelfth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
49. Fifteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asian Tectonics and Resources
50. Third Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
51. First Session of the IOC Group of Experts on the Global Sea-Level Observing System
52. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean
53. First Session of the IOC Editorial Board for the International Chart of the Central Eastern Atlantic ***(Also printed in French)***
54. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico ***(Also printed in Spanish)***
55. Fifth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
56. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean
57. First Meeting of the IOC *ad hoc* Group of Experts on Ocean Mapping in the WESTPAC Area
58. Fourth Session of the IOC Consultative Group on Ocean Mapping

59. Second Session of the IOC-WMO/IGOSS Group of Experts on Operations and Technical Applications
60. Second Session of the IOC Group of Experts on the Global Sea-Level Observing System
61. UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change
62. Third Session of the IOC-FAO Group of Experts on the Programme of Ocean Science in Relation to Living Resources
63. Second Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
64. Joint Meeting of the Group of Experts on Pollutants and the Group of Experts on Methods, Standards and Intercalibration
65. First Meeting of the Working Group on Oceanographic Co-operation in the ROPME Sea Area
66. Fifth Session of the Editorial Board for the International Bathymetric and its Geological/Geophysical Series
67. Thirteenth Session of the IOC-IHO Joint Guiding Committee for the General Bathymetric Chart of the Oceans ***(Also printed in French)***
68. International Meeting of Scientific and Technical Experts on Climate Change and Oceans
69. UNEP-IOC-WMO-IUCN Meeting of Experts on a Long-Term Global Monitoring System
70. Fourth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
71. ROPME-IOC Meeting of the Steering Committee on Oceanographic Co-operation in the ROPME Sea Area
72. Seventh Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño' ***(Spanish only)***
73. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico ***(Also printed in Spanish)***
74. UNEP-IOC-ASPEI Global Task Team on the Implications of Climate Change on Coral Reefs
75. Third Session of the IODE Group of Experts on Marine Information Management
76. Fifth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
77. ROPME-IOC Meeting of the Steering Committee for the Integrated Project Plan for the Coastal and Marine Environment of the ROPME Sea Area
78. Third Session of the IOC Group of Experts on the Global Sea-level Observing System
79. Third Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
80. Fourteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans
81. Fifth Joint IOG-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
82. Second Meeting of the UNEP-IOC-ASPEI Global Task Team on the Implications of climate Change on Coral Reefs
83. Seventh Session of the JSC Ocean Observing System Development Panel
84. Fourth Session of the IODE Group of Experts on Marine Information Management
85. Sixth Session of the IOC Editorial Board for the International Bathymetric chart of the Mediterranean and its Geological/Geophysical Series
86. Fourth Session of the Joint IOC-JGOFS Panel on Carbon Dioxide
87. First Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Pacific
88. Eighth Session of the JSC Ocean Observing System Development Panel
89. Ninth Session of the JSC Ocean Observing System Development Panel
90. Sixth Session of the IODE Group of Experts on Technical Aspects of Data Exchange
91. First Session of the IOC-FAO Group of Experts on OSLR for the IOCINCWIO Region
92. Fifth Session of the Joint IOC-JGOFS CO, Advisory Panel Meeting
93. Tenth Session of the JSC Ocean Observing System Development Panel
94. First Session of the Joint CMM-IGOSS-IODE Sub-group on Ocean Satellites and Remote Sensing
95. Third Session of the IOC Editorial Board for the International Chart of the Western Indian Ocean
96. Fourth Session of the IOC Group of Experts on the Global Sea Level Observing System
97. Joint Meeting of GEMSI and GEEP Core Groups
98. First Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
99. Second International Meeting of Scientific and Technical Experts on Climate Change and the Oceans
100. First Meeting of the Officers of the Editorial Board for the International Bathymetric Chart of the Western Pacific
101. Fifth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico
102. Second Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
103. Fifteenth Session of the Joint IOC-IHO Committee for the General Bathymetric Chart of the Oceans
104. Fifth Session of the IOC Consultative Group on Ocean Mapping
105. Fifth Session of the IODE Group of Experts on Marine Information Management
106. IOC-NOAA *Ad hoc* Consultation on Marine Biodiversity
107. Sixth Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
108. Third Session of the Health of the Oceans (HOTO) Panel of the Joint Scientific and Technical Committee for GLOSS
109. Second Session of the Strategy Subcommittee (SSC) of the IOC-WMO-UNEP Intergovernmental Committee for the Global Ocean Observing System
110. Third Session of the Joint Scientific and Technical Committee for Global Ocean Observing System
111. First Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate
112. Sixth Session of the Joint IOC-JGOFS C02 Advisory Panel Meeting
113. First Meeting of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS)
114. Eighth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of "El Niño" ***(Spanish only)***
115. Second Session of the IOC Editorial Board of the International Bathymetric Chart of the Central Eastern Atlantic ***(Also printed in French)***
116. Tenth Session of the Officers Committee for the Joint IOC-IHO General Bathymetric Chart of the Oceans (GEBCO), USA, 1996
117. IOC Group of Experts on the Global Sea Level Observing System (GLOSS), Fifth Session, USA, 1997
118. Joint Scientific Technical Committee for Global Ocean Observing System (J-GOOS), Fourth Session, USA, 1997
199 First Session of the Joint 100-WMO IGOSS Ship-of-Opportunity Programme Implementation Panel, South Africa, 1997
120. Report of Ocean Climate Time-Series Workshop, Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate, USA, 1997

121. IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional Global Ocean Observing System (NEAR-GOOS), Second Session, Thailand, 1997

122. First Session of the IOC-IUCN-NOAA *Ad hoc* Consultative Meeting on Large Marine Ecosystems (LME), France, 1997

123. Second Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), South Africa, 1997

124. Sixth Session of the IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico, Colombia, 1996 ***(also printed in Spanish)***

125. Seventh Session of the IODE Group of Experts on Technical Aspects of Data Exchange, Ireland, 1997

126. IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), First Session, France, 1997

127. Second Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 1998

128. Sixth Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1997

129. Sixth Session of the Tropical Atmosphere - Ocean Array (TAO) Implementation Panel, United Kingdom, 1997

130. First Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 1998

131. Fourth Session of the Health of the Oceans (HOTO) Panel of the Global Ocean Observing System (GOOS), Singapore, 1997

132. Sixteenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), United Kingdom, 1997

133. First Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1998

134. Fourth Session of the IOC Editorial Board for the International Bathymetric Chart of the Western Indian Ocean (IOC/EB-IBCWIO-IW3), South Africa, 1997

135. Third Session of the Joint GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC), France, 1998

136. Seventh Session of the Joint IOC-JGOFS C02 Advisory Panel Meeting, Germany, 1997

137. Implementation of Global Ocean Observations for GOOS/GCOS, First Session, Australia, 1998

138. Implementation of Global Ocean Observations for GOOS/GCOS, Second Session, France, 1998

139. Second Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Brazil, 1998

140. Third Session of IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional - Global Ocean Observing System (NEAR-GOOS), China, 1998

141. Ninth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of 'El Niño', Ecuador, 1998 ***(Spanish only)***

142. Seventh Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Croatia, 1998

143. Seventh Session of the Tropical Atmosphere-Ocean Array (TAO) Implementation Panel, Abidjan, Côte d'Ivoire, 1998

144. Sixth Session of the IODE Group of Experts on Marine Information Management (GEMIM), USA, 1999

145. Second Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), China, 1999

146. Third Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Ghana, 1999

147. Fourth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC); Fourth Session of the WCRP CLIVAR Upper Ocean Panel (UOP); Special Joint Session of OOPC and UOP, USA, 1999

148. Second Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), France, 1999

149. Eighth Session of the Joint IOC-JGOFS CO2 Advisory Panel Meeting, Japan, 1999

150. Fourth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Japan, 1999

151. Seventh Session of the IOC Consultative Group on Ocean Mapping (CGOM), Monaco, 1999

152. Sixth Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), France, 1999

153. Seventeenth Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), Canada, 1999

154. Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y el Golfo de Mexico (IBCCA), Septima Reunión, Mexico, 1998

IOC Editorial Board for the International Bathymetric Chart of the Caribbean Sea and the Gulf of Mexico (IBCCA), Seventh Session, Mexico, 1998

155. Initial Global Ocean Observing System (GOOS) Commitments Meeting, IOC-WMO-UNEP-ICSU/Impl-III/3, France, 1999

156. First Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Venezuela, 1999 ***(also printed in Spanish and French)***

157. Fourth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), China, 1999

158. Eighth Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series, Russian Federation, 1999

159. Third Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS), Chile, 1999

160. Fourth Session of the IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS). Hawaii, 2000

161. Eighth Session of the IODE Group of Experts on Technical Aspects of Data Exchange, USA, 2000

162. Third Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LME), France, 2000

163. Fifth Session of the IOC-WMO-UNEP-ICSU Coastal Panel of the Global Ocean Observing System (GOOS), Poland, 2000

164. Third Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System (GOOS), France, 2000

165. Second Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, Cuba, 2000 ***(also printed in Spanish and French)***

166. First Session of the Coastal Ocean Observations Panel, Costa Rica, 2000

167. First GOOS Users' Forum, 2000

168. Seventh Session of the Group of Experts on the Global Sea Level Observing System, Honolulu, 2001

169. First Session of the Advisory Body of Experts on the Law of the Sea (ABE-LOS), France, 2001 ***(also printed in French)***

170. Fourth Session of the IOC-WMO-UNEP-ICSU Steering Committee of the Global Ocean Observing System, Chile, 2001

171. First Session of the IOC-SCOR Ocean CO_2 Advisory Panel, France, 2000

172. *Cancelled*

173. Third Session of the *ad hoc* Advisory Group for IOCARIBE-GOOS, USA, 2001 ***(also printed in Spanish and French)***

174. Second Session of the Coastal Ocean Observations Panel and GOOS Users' Forum, Italy, 2001

175. Second Session of the Black Sea GOOS Workshop, Georgia, 2001

176. Fifth Session of the IOC/WESTPAC Co-ordinating Committee for the North-East Asian Regional – Global Ocean Observing System (NEAR-GOOS), Republic of Korea, 2000

177. Second Session of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Morocco, 2002 ***(also printed in French)***

178. Third Session of the Coastal Ocean Observations Panel and GOOS Users' Forum, Vietnam, 2002

179. Fourth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), France, 2002

180. Second Session of the IOC-SCOR Ocean CO_2 Advisory Panel, Honolulu, Hawaii, U.S.A, 2002 ***(electronic copy only)***

181. IOC Workshop on the Establishment of SEAGOOS in the Wider Southeast Asian Region, Seoul, Republic of Korea, 2001 (SEAGOOS preparatory workshop) ***(electronic copy only)***

182. Third Session of the GOOS Users' Forum and Coastal Ocean Observations Panel, Vietnam, 2002

183. Fourth Session of the IOC-IUCN-NOAA Consultative Meeting on Large Marine Ecosystems (LMEs), France, 2002