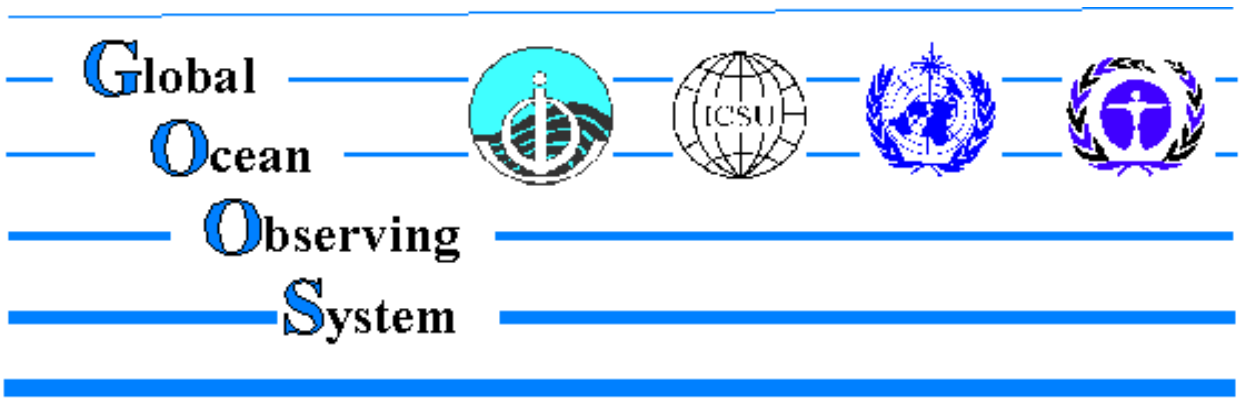

Intergovernmental Oceanographic Commission
Reports of Meeting of Experts and Equivalent Bodies

IOC-WMO-UNEP-ICSU-FAO Living Marine Resources Panel of the Global Ocean Observing System (GOOS)

Fourth Session
Honolulu, Hawaii
1-4 May 2000

GOOS Report No. 91

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IOC-WMO-UNEP-ICSU-FAO/LMR-GOOS-IV/3
Paris, November 2000
English only

Abstract

This report summarizes presentations and discussions at the fourth and last session of the Living Marine Resources Panel of GOOS before its merger into the impending Coastal Ocean Observations Panel (COOP). Participants were briefed on relevant activities of the UN Food and Agriculture Organization (FAO), the International Colour Coordinating Group (IOCCG), the Canadian LMR-GOOS, and discussed potential GOOS Regional Analysis Centers. The panel considered GOOS Principles of Capacity Building, and recommended specific LMR-GOOS training requirements. The panel also discussed the LMR-GOOS strategic design plan, and working groups addressed specific components to the plan.

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1. INTRODUCTION

The meeting was brought to order at 1330 on 1 May by Panel co-Chairs Warren Wooster and Dagoberto Arcos. This is the final meeting of the LMR-GOOS panel, as the LMR, C-GOOS and HOTO-GOOS panels will be merged into a single Coastal Ocean Observations Panel (COOP) later in the year. In preparation for that merger, the principal objective of this meeting is to complete the strategic design plan for LMR-GOOS.

Local host Mike Laurs welcomed the panel to Honolulu and explained the working arrangements. Sonia Batten was designated rapporteur for the meeting.

2. STAKEHOLDERS MEETING

The meeting's Hawaii venue allowed the panel to interact with potential users of LMR-GOOS information and to receive their input. A stakeholders meeting was arranged to bring together representatives of a broad range of user groups, which included: U.S. National Oceanic and Atmospheric Administration (NOAA) (Coast Watch, National Oceanographic Data Center, National Marine Fisheries Service (NMFS)), Audubon Society, U.S. Fish and Wildlife Service, State of Hawaii (Department of Business, Economic Development and Tourism, Department of Fish and Wildlife), Western Pacific Fisheries Management Council, and representatives of Aquaculture interests.

Warren Wooster described the general intent and principles of GOOS and the LMR-GOOS module, and asked the assembled stakeholders to identify useful data and information products that might be provided by GOOS. The following issues were raised:

- Information is sought on oceanic features where large pelagic fishes concentrate. One such feature is the location of ocean convergent areas with high chlorophyll concentrations. The position can be detected through ocean colour sensors.
- Archival tagging of animals of these features (*e.g.*, tunas, billfish, sea turtles, marine mammals) can be very useful in long term monitoring. Archival tags can record location, and from this it is possible to define habitats and evaluate changes in habitat over time.
- Information is needed on sea birds. A long time series of sea bird abundance exists for the Northwestern Hawaiian Islands, but without links with other indicators it is not known whether terrestrial or marine environment changes are causing variability. LMR-GOOS could usefully provide data to evaluate these changes.
- Locally, the size of some tunas caught by recreational fishing is declining. This may be due to changes in availability caused by variability in oceanographic conditions, or could be due to fishing. LMR-GOOS could help to distinguish between fishing and natural factors responsible.
- It would be useful to have information to monitor the health of coral reefs, and whether changes may be caused by local or global events. As a minimum, LMR-GOOS might look at large scale effects and predict their local consequences.
- Open ocean aquaculture is affected by waves, and wave measurements are essential in management. Satellite altimetry is useful for large-scale wave forecasts, but fine scale data are also needed. There was some debate as to whether this information was now available, or would shortly be so.
- Subsurface currents are very important as transport mechanisms for juvenile lobsters. The Array for Real-time Geostrophic Oceanography (ARGO) program may be a useful source of such information.
- Whale watching is now a large source of revenue, and there is increasing research concerned with it and with the natural history of the whales. However, it is necessary to separate out the anthropogenic pressures (for example, too many boats, too close) from oceanographic effects, for example circulation changes and how these might relate to migration patterns. Calf production may be linked to forage success in Alaskan waters, hence the whales may be integrating signals. The data products of GOOS would clearly be useful.

- The retreat of sea ice in the southern ocean, and the consequent decline in krill, which feed on the algae underneath the ice, adversely affects the penguin colonies. Sea ice retreats may be indicators of large scale climate changes. Although sea ice extent is monitored, the linkages to biology need to be developed.
- It was proposed that international organizations could provide a 'modeling service' by compiling environmental and biological data, feeding them into an ecosystem model, and generating maps, for example of primary productivity. This was consistent with the panel's proposal for Regional Analysis Centers (RACs), and it was thought that Hawaii would be an ideal place to locate such a center for the open North Pacific.
- The FAO is trying to establish a set of global indicators, for example landings per year, by country and trying to add others such as age at length, status of the resource. It is also attempting to estimate the historical state of the fishery. It would be helpful to have similar indices for oceanography, not necessarily to establish the links but at least to have an indicator of change.
- Trophic structure was felt to be a fundamental variable that could be monitored. At present the measurements may be difficult to interpret, but we should initiate the observations so that interpretation in the future would be possible.
- Although the southern hemisphere is less well monitored, and therefore the northern hemisphere is a better place to begin, data accumulation from the southern hemisphere should be emphasized.

The issues raised were consistent with the LMR-GOOS panel's deliberations during its previous meetings. There were clearly issues that applied globally but also many specific local issues such as those of open ocean reefs and aquaculture and eco-tourism. It appeared that there was an ideal opportunity in Hawaii, with the necessary research infrastructure already in place, for a RAC to be established, and the chairman challenged the stakeholders and local agencies to consider developing and supporting such a center.

3. REPORTS ON RELEVANT ACTIVITIES

3.1 FAO

Jorge Csirke reported that FAO intends to continue supporting LMR-GOOS and welcomes the opportunity to influence the way in which LMR-GOOS develops its work regarding the monitoring of living marine exploitable resources and related environmental factors. FAO is currently involved in a large exercise to develop and adopt a set of fishery resource and more general fisheries indicators to simplify the monitoring and reporting on the state of world fisheries and fishery resources. These might include commonly agreed and accepted indexes of stock abundance, recruitment strength, biodiversity, discards, fish production, fishing pressure, market prices, etc. It is hoped that comparable indicators can be developed for the monitoring and reporting of regional and global environmental conditions affecting fisheries or being affected by fisheries related factors.

FAO has received support to develop a 'portal', or Internet Web-based interface that could allow individual governments, national institutions and/or regional organizations to report directly on the state of exploited living marine resources, as well as on other fisheries related factors and parameters (including, for instance, information on trade, capital investment, fishing gear, fishing fleets, etc.). This is perceived as a major commitment both for FAO and for the reporting national/regional institutions and organizations that goes well beyond their current commitments regarding the reporting and dissemination of fisheries data. For instance, at present all FAO member countries have agreed and are therefore required to provide detailed annual landing statistics by species and major FAO statistical area. This has allowed FAO to assemble a valuable database of fish production statistics (including capture fisheries and aquaculture) by species, country and statistical area (including marine and inland waters). However, even where firm commitments to provide this information in a timely manner exist, some countries don't provide it, or provide unreliable or incomplete reports. In some cases this may be because the country does not have the necessary

resources to gather the basic data, however even some developed countries fail to comply fully with the information requirements for landings data. It is thus likely that obtaining complete, reliable and timely data on biomass, by-catch, discards, undersized fish landings, etc., is and/or will be even more problematic.

FAO would like LMR-GOOS to provide indicators of 'health of the environment' to compare with 'health of the resources'. This could include, for example, indicators of primary productivity, sea surface temperature, upwelling, and other monitored environmental parameters.

There are already some data provided on fishing vessels, including vessel size, type, construction year, change of ownership, etc., for the larger fishing vessels in the Lloyds registry. Furthermore, FAO has had some success asking countries to report on a voluntary basis the number and size of smaller fishing vessels. There are also attempts to collect information on fishing gear.

FAO is developing FIGIS (Fisheries Geographic Information System), which will allow national institutions and regional organizations (*e.g.*, ICES), to feed detailed data on fisheries, fishery resources and related environmental factors directly into FAO-based databases and/or establish and maintain links through which these data can be easily traced and accessed by the international community. Although it is intended that FIGIS contain ecosystem indicators, there has been little progress with respect to identifying specifically what these indicators would be and it is hoped that LMR-GOOS can provide input here. It was also stressed that when it comes to ecosystem management indicators, an entirely new set of multiple-use and governance issues emerge which go well beyond purely fisheries related issues.

The panel observed that in regions where FAO has a strong base, it should have an important role in developing RACs. It was also noted that FAO has no direct involvement with other GOOS panels. However, it was hoped that the FAO role in LMR-GOOS could be transferred to the new merged panel, COOP.

3.2 IOCCG

The International Ocean-Colour Coordinating Group (IOCCG) was established in 1996, under the auspices of the Intergovernmental Oceanographic Commission (IOC). In 1998 the group became an Affiliated Program of the Scientific Committee on Oceanic Research (SCOR) which provides infrastructure support and financial management for the group. In November 1999 the IOCCG became an Associate Member of the Committee on Earth Observation Satellites (CEOS).

The IOCCG is a committee of experts in the field of satellite ocean colour, which acts as a liaison and communication channel between providers (*i.e.* Space Agencies) and users (scientist, managers and researchers) of ocean-colour data. Aims of the IOCCG include promoting strong international cooperation and coordination in the acquisition, calibration, validation, distribution and utilization of ocean-colour data as well as broadening the user community for ocean-colour data, particularly in developing countries, through advanced training courses.

Activities of the IOCCG are sponsored by several major Space Agencies and other institutes including NASA (National Aeronautics Space Administration), NASDA (National Space Development Agency of Japan), ESA (European Space Agency), JRC (Joint Research Centre, EC), IOC (Intergovernmental Oceanographic Commission) and CNES (Centre National d'Etudes Spatiales).

Over the past four years, seven satellites carrying ocean-colour sensors have been launched by various nations (one of these has since ceased to function), with a further three satellites scheduled for launch by the end of 2001. Many of these missions have different technical and hardware requirements and not all provide global coverage. There is a need for coordination of these satellites as well as for the acquisition, distribution and calibration of the data, which is the role of the IOCCG.

Activities of the IOCCG can be divided into four broad areas:

- formation of specialized scientific working groups to address issues of importance in the ocean-colour arena and to produce a report on the topic (two reports published, one in press, four working groups in progress);
- provision of training opportunities in developing countries (three courses held in Chile, India and Thailand, three others planned);
- coordination with other relevant scientific programs such as those of SIMBIOS, JGOFS, IGOS and GOOS;
- advocating the importance of ocean-colour data to the global community through a comprehensive homepage (www.ioccg.org), information-folders and newsletters.

Information on ocean color products and applications can be found in Annex IV.

3.3 COOP/GOOS MERGER

Warren Wooster reported on the meeting held 17-18 April in Washington, D.C. at which the merger of LMR-GOOS with C-GOOS and HOTO was discussed. Coastal and shelf monitoring would be the responsibility of the new Coastal Ocean Observations Panel (COOP) while global open-ocean monitoring and modeling would be under the Ocean Observations Panel for Climate (OOPC). The scope of COOP was defined as follows:

The COOP will plan and facilitate implementation of an end-to-end observing system to provide systematic data sets and products to users. Goals are to monitor, assess, and predict effects of natural variations and human activities on the marine environment and ecosystems of the coastal ocean. Principal foci are on issues of ecosystem (including human) health, living marine resources, natural hazards, and safe and efficient marine operations. The area of concern extends from land influences on estuaries to the deep ocean as required to provide products.

It was noted that living resource issues extending beyond the continental shelf should for the time being be dealt with by COOP as should be the topics of aquaculture and inshore fisheries not addressed by LMR. Membership of the new panel will include, *inter alia*, a few members from each of the component panels. COOP will involve the merging of the strategic design plans from the panels, which are at different stages of development. In keeping oceanic and coastal fisheries together under COOP, it will be a challenge to ensure that the data needs of the oceanic area are taken care of by the OOPC, which should therefore include biological representation. There must also be a clear intention to retain FAO involvement in COOP.

3.4 CANADIAN LMR – GOOS WORKSHOP

A Canadian workshop on LMR-GOOS was held at Bedford Institute of Oceanography from 29 to 31 March 2000. Six ecosystem objectives for integrated oceans management had been proposed, as a follow-up to the ICES/SCOR Symposium on the Ecosystem Effects of Fishing. Three of the objectives address the biodiversity obligations under the Convention for Biological Diversity (CBD). The additional three objectives address habitat productivity concerns, including the standard conservation objectives for the target species in fisheries management plans. The objective of the workshop was to define indicators for each of the six conservation objectives. The monitoring program for LMR-GOOS should, in principle, provide data products to support the indicators for the conservation objectives of management of ocean industries.

Invited presentations were prepared on potential indicators for each of the conservation objectives. The presentations were followed by comments of a pre-assigned respondent as well as general discussion. A summary of the indicators (as well as possible reference points for decision making) is provided in Table 1. It was concluded that establishing causality between a particular

ocean use activity and a change in an indicator for a particular conservation objective may be challenging. Thus the LMR-GOOS monitoring program needs to include measures of oceanographic properties in addition to those in support of the indicators listed in the table. The present oceans monitoring program for Canada was presented and gaps identified with respect to meeting the needs of integrated oceans management.

During the discussion of the Canadian workshop there was general support for including ecosystem objectives for integrated oceans management within the LMR-GOOS framework.

Table 1. Examples of Ecosystem Objectives, Indicators and Reference Points for Ocean Management Areas (OMAs)

Objectives	Indicator	Reference Points
Maintenance of ecosystem diversity	Areas of the continental shelf disturbed by fishing activities	Percentage of each habitat type that is undisturbed
Maintenance of species diversity	• Number of individuals of the species at risk • Geographic area of distribution	• Maximum by-catch annually • Percentage of distributional area relative to period of moderate abundance
Maintenance of genetic variability within species	• Number of spawning populations of targeted species • Selection differentials	• Percentage reduction in spawning areas • Minimum selection differential
Maintenance of directly impacted species	• Fishing mortality • Spawning stock biomass • Area of distribution	• $F_{0.1}$ • Minimum stock biomass necessary for recruitment and forage • Percentage of distribution relative to period of moderate abundance
Maintenance of ecologically dependent species	• Abundance of key predator • Condition of key predator • Percentage of prey species in diet of predator	• Minimum abundance level of predator • Minimum condition level of predator • Minimum percentage in diet of predator
Maintenance of ecosystem structure and function	• Slope of size spectrum • k-dominance curves • Pauly's FIB index • Aggregate annual removals by fishing for each trophic level	• Percent change in slope of size spectrum • Maximum "humpiness" change in k-dominance curve • Minimum level for index • Maximum percentage removal from a trophic level

3.5 REGIONAL ANALYSIS CENTERS (RACS)

The panel briefly discussed the Regional Analysis Centers which had been proposed at the LMR-III. It was hoped that international organizations, such as ICES, PICES, FAO and also the BENEFIT program, would play an important role in developing and coordinating these centers. The panel stressed that there would be many users of such facilities, not just the fisheries. In the Pacific, where highly migratory stocks are a key issue, international agreements are required for such coordination. There are political issues since the stocks move between the EEZs of many countries.

The panel felt that indicators of the state of the environment and its ecosystems were needed as a product of such RACs, but it was essential to include a research element in the work of the center to strengthen the possibilities of forecasting. While conservation objectives may be set on the basis of both scientific and political criteria, the concern of the panel is with enhancing the natural science inputs to the management process.

4. CAPACITY BUILDING

4.1 PRINCIPLES OF CAPACITY BUILDING

The GOOS capacity building principles take cognizance of the following, among others:

i) that GOOS can only be successfully implemented through the combined efforts of all IOC Member States;
ii) that requirements for and interests in GOOS vary from region to region, country to country and even within individual countries;
iii) that capabilities to contribute to and benefit from GOOS also vary widely among countries and regions.

The LMR-GOOS panel endorses these principles as well as the following:

i) that capacity building is a long-term process and that the necessary activities vary from a single training course to the installation of a complete environmental monitoring system;
ii) that the involvement of the recipient government is crucial;
iii) that governments, international organizations, the private sector, and donors should join forces to build the necessary capacity for GOOS;
iv) that all participants must recognize the need to sustain capacity once it has been built;
v) that creation of awareness in the minds of the public and policy makers is essential for raising national and international support;
vi) that the building of capacity of countries to participate in and benefit from GOOS on a continuing basis is regarded as essential for the effective development of a continuing global ocean observing system.

The LMR-GOOS panel perceives capacity building to include provision of skills, experience and infrastructure. It is noted that capacity building is essentially limited to developing countries because the necessary skills exist in developed countries. Only the distribution of these skills may be a problem. It is noted that many participating countries could easily take charge of basic monitoring activities implying that capacity building should be towards provision of specialised skills and infrastructure. The panel, however, takes cognisance of the fact that in the next decade there is the possibility of a quantum leap in technology applicable to marine sciences. To implement LMR GOOS, basic and specialised skills are required as well as experience and infrastructure. There is therefore, the need to match the necessary infrastructure with the appropriate skills.

4.2 TRAINING REQUIREMENTS

In view of the anticipated change in technology, training for capacity building should be done at all levels and involving scientists, technicians, managers and observers on board fishing vessels. It is noted, however, that some of this training could be obtained through distance learning programs from interactive websites. To rganiza capacity building, GOOS could prioritise participating countries' needs according to the following criteria, among others:

i) total annual fish catch by country,
ii) importance of living marine resources (especially fisheries) to the economy of the country, and
iii) the willingness of the country to accept training and to participate in GOOS.

The panel is of the opinion that identification of such countries would effectively be done by IOC through its TEMA program and in conjunction with FAO. This will also facilitate the identification of the available skills and expertise, assessment of shortcomings and gaps in expertise and assessment of critical areas for capacity building. The areas for training that would produce the essential skills for LMR-GOOS are as follows:

- Hydroacoustic techniques (for fish and plankton surveys)
- Capabilities in image processing and applications of satellite remote sensing to oceanography and fisheries
- Expanded GIS capabilities
- Database management and information sharing
- Numerical expertise in fisheries science
- Ecosystem-based modeling skills
- Multidisciplinary training for fisheries managers, especially in ecosystem and biodiversity management, seabed mining, law of the sea, etc.
- Integrated coastal area management
- Genetic methods and application
- General training of oceanographic technicians
- Training of fisheries inspectors and observers
- Environmental monitoring
- Language education

The necessary infrastructure would span the complete spectrum from basic tools to utilization of Internet facilities and would include:

- Computers and relevant software
- Internet connection
- Internal and external communication
- Equipment and sampling gear for *in situ* measurements and processing
- Laboratory equipment

4.3 NOTES ON LMR-GOOS IMPLEMENTATION

The panel notes, however, that some of the skills and infrastructure would be required only at the regional level in accordance with the principle of identifying Regional Activity Centers. The panel endorses the idea that regional frameworks can increase the effectiveness of scarce resources and the efficiency of local observing, research, data management and prediction network and help to sustain the capacity building activity by assisting with continuing upgrades of new communications, models, sampling technology, products, and other needs.

To run an LMR-GOOS monitoring program will require a significant increase in trained observers. Training in essential skills and expertise will require the cooperation and assistance of

governments, non-governmental organizations, international organizations (*e.g*. IOC, FAO, ICLARM), universities and aid agencies (*e.g*. GTZ-Germany, JICA-Japan, DFID-U.K., KOICA-Korea and USAID -USA). Aid agencies could be asked to tailor their training programs towards provision of essential skills for GOOS. In this regard, the panel recommends that recipient countries use the framework provided by GOOS when asking for assistance from the donor community. This in turn greatly depends on the importance that countries will place on the GOOS program. In this regard, the panel recommended that IOC take the initiative in awareness creation at the level of the Commission by impressing national representatives of the importance of GOOS.

Universities need to consider shifting towards provision of training and education in broad ecosystem analysis in addition to their usual training in specialized fields. To ensure that the capacity built is sustained, trained personnel need to be assisted to train others.

5. THE LMR-GOOS STRATEGIC DESIGN

5.1 GENERAL DISCUSSION

A draft strategic design had been compiled from available material, including that in reports of previous LMR meetings. The panel discussed the various elements and commented on changes that might be necessary. The following points were raised:

The panel noted the need for an "ocean use audit." For example it would be very useful to have recorded the positions (latitude and longitude) where each individual gear type was used, particularly for trawl fisheries. Some nations do have this type of information although FAO is not currently monitoring it.

US law requires that essential fish habitats (EFH) be defined for each specific stock. The panel felt that this would be particularly relevant for coastal zone management and accepted that it would be hard to define for some fisheries (*e.g*. tunas and other highly migratory species). Estuaries can be essential to a specific life cycle stage of a given stock and thus are EFH that if destroyed can lead to the destruction of the whole population over a wide area. The consensus view was that the panel did not need to elaborate this issue in full in the strategic design.

There was debate on whether or not the lack of 'habitat' as a variable in the Table of Possible Regional Observations (see LMR-II Report) was an oversight. It was felt by some that it was not the same type of measurement as those already included and so might seem inappropriate. A compromise would be to include it in both the table and in the text of the design plan.

The panel agreed that the strategic design should emphasize the RACs and should characterize them. Possible locations might include those in Hawaii (for central Pacific) and in the North Pacific and North Atlantic as arranged through PICES and ICES respectively. A website should be set up to coordinate the products of monitoring and analysis, and although parameters to be analyzed could be suggested as examples, each region should select its own parameters according to the users and the support required. The panel also discussed whether RACs should be built around FAO areas or LMEs. FAO accepts that its areas are too general in many cases and they are taking steps to produce data for smaller areas. Although the LMEs were seen as more suitable areas, the individual RACs will need to decide, based on their expertise.

The issue of data management was also discussed. C-GOOS has developed an extensive data and information management plan which in view of the impending merger need not be duplicated in the LMR plan. Data management for LMR will be addressed in the context of COOP. It is important to keep in mind that biological data carry different data management problems than physical and chemical data, and systems for managing complex biological data sets, much less ecosystem data, are yet to be developed. The Census of the Fishes program is planning to step into this issue through

OBIS (Ocean Biological Information System), but the panel was insufficiently informed on that project to be able to assess fully its utility to LMR-GOOS. It was also noted that commercial firms might already have developed systems which can deal efficiently with complex metadata and produce required products.

During the discussion, two recommendations were agreed: (1) Biological data exchange should be built into NEAR-GOOS in the near future. At present only climate and physical data are exchanged. The exchange of biological data has been a sensitive issue in the NEAR-GOOS region, particularly for LMR data. This problem must be overcome before an operational LMR-GOOS program can be established in the region. (2). The Yellow Sea LME project was recommended for inclusion in the IGOSS Observing System (IOS). This project began in 1997 and there are plans to deploy three CPRs starting in 2000, and to conduct resource surveys across the entire Yellow Sea. This program represents an important component of a regional LMR-GOOS for NE Asia, and should be part of the IOS.

5.2 DEVELOPMENT OF THE LMR-GOOS STRATEGIC DESIGN

Two half-days were spent in refining the draft design plan based on the panel discussions. For this purpose, breakout groups were established, with the following membership and assignments:

AM 3 May

1. Coastal fisheries in upwelling systems – Bakun, Hutchings, Lluch-Belda
2. Yellow Sea/East China Sea – Zhang, Sugimoto
3. Gulf of Guinea – Koranteng, Cyr
4. Research, liaison with existing observing systems – Arcos (Chair), Sinclair, Laurs, Wooster, Batten, Shiganova, von Bodungen, Harris, Csirke, Stuart

PM, 3 May

5. Open ocean – Wooster, Laurs, Batten
6. Scotian Shelf – Sinclair
7. Benefits and products – Arcos (Chair), Harris, Csirke, Sugimoto, Stuart, Cyr
8. Capacity Building – Koranteng (Chair), Shiganova, von Bodungen, Bakun, Zhang, Lluch-Belda, Hutchings

The following day was spent in reviewing the outputs of these groups. The contributions will be compiled and edited, and the design plan will be circulated to panel members for their review before it is submitted to the GOOS Project Office. Annex 5 contains an outline of the document as revised.

6. CLOSING

The Chair thanked Mike Laurs and his assistant, Wende Goo, for their hospitality and assistance in making this last meeting of LMR-GOOS a success. Thanks were also expressed to panel members and observers and to Ned Cyr of the IOC Secretariat for their participation and contributions to the work of the panel. All hoped that the work of the new combined panel, COOP, would benefit from the efforts of the LMR-GOOS team.

ANNEX I

AGENDA

Monday, 1 May – 1330-1700

(Note: Full panel meets 1330-1500. Stakeholders meeting will be 1500-1700)

1. Welcome – Laurs

2. Opening Remarks – Wooster and Arcos

3. Meeting Objectives - Wooster [1. Complete the strategic design plan for LMR GOOS; 2. outline the implementation plan]

4. Working Arrangements – Cyr/Laurs

5. Stakeholders Meeting

Tuesday, 2 May – 0900–1730

6. Reports on relevant activities
   FAO – Csirke/Bakun
   IOCCG – Stuart
   COOP/GOOS Merger Meeting – Wooster/Cyr
   Canadian LMR-GOOS Workshop – Sinclair

7. LMR-GOOS strategic design - *Review draft sections of the strategic design for feedback prior to breaking into working groups.*
   Conceptual approach and general overview - Wooster
   Observing System Elements
   Open ocean observing system – Wooster, Laurs
   Coastal ocean system
   Regional examples – Scotian shelf – Sinclair
   Yellow Sea/East China Sea – Zhang/Sugimoto
   Upwelling systems – Hutchings/Bakun/Arcos
   Gulf of Guinea - Koranteng
   Critical habitat – Laurs/von Bodungen
   Benefits and products - All
   Capacity building – Koranteng
   IOS and Pilot Projects – All
   Research - All
   Other

Wednesday, 3 May – 0830-1730

8. Breakout working groups to refine strategic design plans based on panel feedback (working group assignments attached)

Thursday, 4 May – 0830-1730

Working groups present revised text. Review and discussion.

9. Implementation plan development – Wooster

10. Assignments and next steps

Thursday evening luau (location to be announced).

Working Group Assignments

Wednesday morning

1. Coastal Fisheries in Upwelling Systems – Bakun, Hutchings, Lluch-Belda
2. Yellow Sea/East China Sea – Zhang, Sugimoto
3. Gulf of Guinea – Koranteng, Cyr
4. Research; Liaison with existing observing systems – Arcos (Chair), Sinclair, Laurs,Wooster, Batten, Shiganova, von Bodungen, Harris, Csirke, Stuart

Wednesday afternoon

5. Open ocean – Wooster, Laurs, Batten
6. Scotian Shelf – Sinclair
7. Benefits and products – Arcos (Chair), Harris, Csirke, von Bodungen, Sugimoto, Stuart, Cyr
8. Capacity building – Koranteng (Chair), Shiganova, Bakun, Zhang, Lluch-Belda, Hutchings

ANNEX II

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ANNEX III

OCEAN COLOR PRODUCTS AND APPLICATIONS

The core products produced by multi-spectral ocean-colour sensors include concentration of chlorophyll-a, concentration of inorganic suspended sediments and concentration of coloured dissolved organic material (CDOM). Numerous other products or demonstration products are produced by various agencies including light attenuation coefficient, bloom type, bottom depth, chlorophyll fluorescence, photosynthetically active radiation, etc. Furthermore, a number of derived products can be calculated from the core products such as water column primary production, physical exchanges (sedimentation rates, physical exchanges) and benthic primary production.

Chlorophyll-a is an index of phytoplankton biomass and can be used to map the distribution and concentration of phytoplankton on a synoptic scale. There are three broad applications of ocean-colour data. Firstly, since phytoplankton fix carbon dioxide during photosynthesis, ocean-colour data can be used to quantify the ocean-atmosphere fluxes of carbon and to help understand how it is controlled and why it varies from year to year. This is of major importance in climate change research. Global ocean-colour data sets are also useful in understanding phenomena such as El Niño. Secondly, ocean-colour data may be used in the general area of coastal zone management, including fisheries management. Ocean-colour maps of pigment distribution may be used directly to help predict the presence of fish shoals for operational fishing fleets, or they may be used to provide long-term data for analysis of decadal trends in exploited fish stocks. Ocean-colour data are also useful for many other aspects of coastal-zone management, *e.g.* monitoring harmful algal blooms, applications to aquaculture, conservation and monitoring coastal pollution (water quality).

Lastly, since phytoplankton control the optical turbidity in most parts of the ocean they also control the manner in which the mixed layer heats up under the influence of the sun. The transmissibility of visible light through the ocean is an important element in physical models that calculate the depth and temperature of the mixed layer, which is critical for weather forecasting in maritime areas.

The IOCCG's observational requirements, as submitted to the CEOS-WMO database (February, 2000) are shown in Table 1. Requirements are more stringent for the coastal ocean than for the open ocean, with respect to spectral, temporal and spatial resolution.

Annex III

IOCCG Observational Requirements

Horizontal Resolution, Accuracy, Observing Cycle and Delay of Availability are all expressed as Optimum/Threshold values.

Geophysical Parameter	**Unit of Measure**	**Database Abbreviation**	**Horizontal Resolution**	**Accuracy**	**Observing Cycle**	**Delay of Availability**	**Priority**	**Confidence Level**
Top of atmosphere radiance* (Coastal Ocean)	$W\ m^{-2}\ sr^{-1}\ \ m^{-1}$	TOARCO	0.05 km 0.5 km	% max=1% % max=2%	1 h 2 d	1 h 2 weeks	3	3
Top of atmosphere radiance+ (Open Ocean)	$W\ m^{-2}\ sr^{-1}\ \ m^{-1}$	TOAROO	0.5 km 10 km	% max=1% % max=2%	1 d 10 d	1 h 2 weeks	3	1
Water-leaving radiance* (Coastal ocean)	$W\ m^{-2}\ sr^{-1}\ \ m^{-1}$	WLRCO	0.05 km 0.5 km	% max=1% % max=2%	1 h 2 d	1 h 2 weeks	3	3
Water-leaving radiance+ (Open ocean)	$W\ m^{-2}\ sr^{-1}\ \ m^{-1}$	WLROO	0.5 km 10 km	% max=1% % max=2%	1 d 10 d	1 h 2 weeks	3	1
Photosynthetically active radiation	$W\ m^{-2}$	PAR	0.05 km 0.5 km	3% 10%	1 h 1 d	1 h 2 d	3	3
Yellow substance absorbance at 412 nm (Coastal ocean)	m^{-1}	AY412	0.05 km 0.5 km	10% 20%	1 h 2 d	1 h 2 d	3	3
Suspended sediment Concentration **(Coastal ocean)**	$g\ m^{-3}$	SSCCO	0.05 km 0.5 km	10% 20%	1 h 2 d	1 h 2 d	3	3
CHLOROPHYLL (Coastal Ocean)	$mg\ m^{-3}$	CHLCO	0.05 km 0.5 km	10% 30%	1 h 2 d	1 h 2 weeks	3	1
CHLOROPHYLL (Open Ocean)	$mg\ m^{-3}$	CHLOO	0.5 km 10 km	10% 30%	1 d 10 d	1 h 2 weeks	3	1

* Radiance measurements required at fifteen 10-nm wide bands between 400 and 900 nm, specifically centered at 412, 443, 490, 510, 560, 620, 665, 681, 709, 754, 760, 780, 870, 890, and 900 nm.

+ Radiance measurements required at five 20-nm wide bands between 420 and 900 nm, specifically centered at 443, 490, 550, 750 and 870 nm.

ANNEX IV

STRATEGIC DESIGN PLAN OUTLINE

Outline of LMR-GOOS Strategic Design Plan

1. Conceptual approach
    - 1.1 The three-system approach
    - 1.2 Regional approach
    - 1.3 Ecosystem approach
    - 1.4 The role of research
    - 1.5 Importance of fisheries and other ecosystem goods and services
    - 1.6 Design principles for regional LMR-GOOS monitoring systems

2. Observing system elements
    - 2.1 Open ocean system
    - 2.2 Coastal ocean systems
    - 2.3 Inshore systems
    - 2.4 Critical habitat

3. Data and information management

4. Benefits and products
    - 4.1 Regional analysis Centers

5. Capacity building

6. LMR-GOOS elements of the initial observing system

7. LMR-GOOS Pilot Project

Appendix 1. LMR-GOOS observing system elements
    - 1.1 Table of possible regional observations
    - 1.2 Table of possible regional monitoring products

Appendix 2. Regional monitoring systems
    - 2.1 Open ocean systems
    - 2.2 Coastal fisheries in upwelling systems
    - 2.3 Scotian shelf ecosystem off Atlantic Canada
    - 2.4 Yellow Sea and East China Sea
    - 2.5 Gulf of Guinea

Appendix 3. LMR-GOOS IOS elements

Appendix 4. LMR-GOOS Pilot Projects

Appendix 5. Contribution of GLOBEC to developments of LMR monitoring

ANNEX V

LIST OF ACRONYMS

Argo	Array for Real-time Geostrophic Oceanography
AY412	Yellow substance absorbance at 412 nm (Coastal ocean)
BENEFIT	Benguela Environment Fisheries Interaction and Training
CBD	Convention for Biological Diversity
CDOM	Coloured Dissolved Organic Material
CEOS	Committee on Earth Observation Satellites
C-GOOS	Coastal GOOS
CHLCO	Chlorophyll (Coastal Ocean)
CHLOO	Chlorophyll (Open Ocean)
CNES	Centre National d'Etudes Spatiales (France)
COOP	Coastal Ocean Observations Panel
CPR	Continuous Plankton Recorder
DFID	Department for International Development (UK)
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitats
ESA	European Space Agency
FAO	Food and Agriculture Organization (UN)
FIGIS	Fisheries Geographic Information System
GOOS	Global Ocean Observing System
HOTO	Health of the Oceans (module of GOOS)
ICES	International Council for the Exploration of the Sea
ICLARM	International Center for Living Aquatic Resources Management
ICSU	International Council for Science
IOC	Intergovernmental Oceanographic Commission
IOCCG	International Ocean-Colour Coordinating Group
IOS	IGOSS Observing System
JICA	Japan International Cooperation Agency
JRC	Joint Research Centre, EC
KOICA	Korean International Cooperation Agency
LMR	Large Marine Ecosystem
LMR	Living Marine Resources (module of GOOS)
NASA	National Aeronautics Space Administration (USA)
NASDA	National Space Development Agency (Japan)
NEAR-GOOS	North-East Asian Regional GOOS
NMFS	National Marine Fisheries Service (USA)
NOAA	National Oceanic and Atmospheric Administration (USA)
OBIS	Ocean Biological Information System
OMA	Ocean Management Areas
OOPC	Ocean Observation Panel for Climate
PAR	Photosynthetically active radiation
PICES	North Pacific Marine Science Organization (Pacific ICES)
RACs	Regional Analysis Centers
SCOR	Scientific Committee on Oceanic Research
SSCCO	Suspended Sediment Concentration (Coastal ocean)
TOARCO	Top of atmosphere radiance (Coastal Ocean)
TOAROO	Top of atmosphere radiance (Open Ocean)
UNEP	United Nations Environment Programme
USAID	United States Aid for International Development
WLRCO	Water-leaving radiance (Coastal ocean)
WLROO	Water-leaving radiance (Open ocean)
WMO	World Meteorological Organization (UN)

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:

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12. Joint 100-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
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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
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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)***
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45. Ninth Session of the IOC-UNEP Group of Experts on Methods, Standards and lntercalibration
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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
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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)***
116. 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 Off ices 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)***

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