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**INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION**  
(of UNESCO)

**IOC OCEAN SCIENCES SECTION:  
OVERVIEW AND EXPECTED RESULTS, 2005**

This is a brief report on of the Ocean Science Section and the expected results during the mid-term strategy. The report has been prepared by the IOC Secretariat. Also available in French.

## **The IOC and Marine Scientific Research**

As an intergovernmental organization, the IOC serves as a liaison between the marine scientific research community and the governments of Member States by creating an international forum for recommending, promoting, planning, and coordinating international ocean and coastal area programmes in research and the dissemination and use of their results (IOC Statutes, Articles 2 and 3). In recognition of its mandate as the U.N. focal point for marine scientific research, the IOC also provides a direct link between Member States and those UN agreements and conventions dealing with ocean and coastal issues. These activities are carried out in collaboration with international organizations concerned with the work of the Commission, and especially with other appropriate organizations of the United Nations system.

### **The Ocean Science Section of the IOC (OSS)**

Consistent with the IOC Statutes, the activities and products of the Ocean Science Section respond to needs of the Member States, UN Agreements, and the decisions of the UN General Assembly, including recommendations of the Informal Consultative Process on Oceans and the Law of the Sea (ICP). Specifically, the IOC is called on to promote and coordinate activities related to:

- UN Framework Convention on Climate Change (UNFCCC),
- UN Conference on Environment and Development (UNCED),
- World Summit on Sustainable Development (WSSD),
- Convention on Biological Diversity (CBD), and
- The UN Interagency Group of Experts on Scientific Aspects of Marine Pollution (GESAMP).

The OSS also interacts with regional conventions, organizations and programmes such as ICES, PICES, and the UNEP Regional Seas Programme and related conventions. The activities and products of the Ocean Science Section are thus designed to:

- catalyse research to focus on issues important to the Member States and UN Agreements.
- coordinate national and regional efforts to produce global results and advice, and
- communicate the results of these activities to the UN Conventions, Member States, and the general public.

## Overview of Ocean Science Section Activities

The Ocean Science Section carries out its mandate to catalyse, coordinate, and communicate marine scientific research for Member States and UN conventions through establishment of targeted working groups, sponsorship of global research programmes, participating in and leading UN interagency groups, and publishing results of its programmes in both scientific literature and literature for the general public and decision makers.

### **Establishment and Implementation of Working Groups or Panels to Address Specific Issues of Marine Scientific Research:**

- Harmful Algal Blooms
- Environmental Indicators for the Health of Ecosystems
- Monitoring Ocean CO<sub>2</sub> and Assessing Effects on Marine Ecosystems
- Environmental Indicators for Fisheries Management
- Developing strategies for global ocean observations for climate monitoring, prediction, and research
- Coastal Eutrophication
- Capacity Building and Development of Socio-economic Indicators for Coastal Area Management

### **Sponsorship of Global Research Programmes:**

- Global Ocean Ecosystem Dynamics (GLOBEC) Project
- Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB)
- The World Climate Research Programme (WCRP)
- The Large Marine Ecosystems (LME) Project
- Geosphere-Biosphere Coupling Processes in Relation to the Protection of the Marine Environment and High Seas (Training through Research Programme)
- Land-Ocean Interactions in the Coastal Zone (LOICZ)

### **Provision of Secretariat Support, as requested, for UN Interagency Activities:**

- The UN Interagency Group of Experts on Scientific Aspects of Marine Pollution (GESAMP)
- UN-Oceans
- Global Marine Assessments

### **Communications, Publications, and Outreach:**

- Results of working groups and research programmes communicated through peer-reviewed scientific literature, articles for the general public, and official reports for Member States and UN conventions.

These activities are carried out through three thematic programme areas:

- Oceans and Climate,
- Science for Ocean Ecosystems and Marine Environmental Protection (SOEMEP), and
- Science for Integrated Coastal Area Management (ICAM).

*(For more information on OSS see IOC/INF-1155 “IOC Ocean Science Section: A Basis for Restructuring”, IOC-XXI 2 Annex 6, April 2001 and IOC/INF-1180 prov., January 2003.)*

**Overall Expected Results for the IOC Ocean Science Section with Performance Indicators adopted in 32 C/5:**

Expected Results	Performance Indicators
Scientific and technical guidance to Member States enhanced on observations and research needed to understand the ocean’s role in the climate change and in the global carbon cycle.	<ul style="list-style-type: none"> <li>▪ International forum created.</li> <li>▪ Scientific advice and technical guidance published and disseminated.</li> </ul>
Capacities of Member States for monitoring and prediction of harmful algal blooms (HABs) improved.	<ul style="list-style-type: none"> <li>▪ Publication of scientific results on improved understanding of factors controlling Harmful Algal Blooms.</li> <li>▪ Adoption of national science-based strategies for monitoring and predicting blooms by a number of countries.</li> </ul>
Capacity of scientific and research programmes increased to assess the health of the ocean ecosystems.	<ul style="list-style-type: none"> <li>▪ Easy to use indicators developed to assess ocean ecosystem health.</li> <li>▪ Models developed to assess effects of human activities on ocean ecosystems.</li> </ul>
Capacity of coastal countries and regions to undertake Integrated Coastal Area Management (ICAM) increased.	<ul style="list-style-type: none"> <li>▪ A set of global and regional assessments conducted.</li> <li>▪ A number of pilot projects implemented in several regions.</li> <li>▪ A number of measurement indicators developed.</li> <li>▪ Technical and scientific guidelines and tools published and disseminated.</li> </ul>
Capacities of African Member States for regional coastal management enhanced.	<ul style="list-style-type: none"> <li>▪ Number of countries provided with scientific and technical assistance.</li> <li>▪ Number of workshops conducted.</li> <li>▪ Number of coastal managers and scientists trained.</li> <li>▪ Number of coastal projects implemented.</li> <li>▪ Number of publications on scientific and technical guidance.</li> </ul>

## Expected Results of Thematic Programme Areas

### **I. OCEANS AND CLIMATE**

#### **I.1 Expected Results**

- Further development of strategies and implementation plans for global ocean measurements for climate monitoring, prediction, and research, through OOPC actions in support of the GCOS, the global module of GOOS, and the WCRP, and including scientific priorities, observing system elements, and structural challenges in the completion of the global network.
- Coordination of national climate research strategies for improved understanding of the ocean's role in climate variability and change, through the WCRP and its CLIVAR research programme.
- Dissemination of information products for improved analyses and predictions of ocean circulation, through GODAE, an OOPC pilot project;
- Further development of a recognized, international project for the coordination of ocean carbon observations and data, linking existing programmes such as CLIVAR, LOICZ, SOLAS, IMBER, and national and regional research programmes. These activities are fully integrated with the atmosphere and land domain research and observations through partnership with the IGBP-WCRP-IHDP Global Carbon Project and the IGOS-Partners Integrated Global Carbon Observation theme;
- Further development of a strategy and implementation plan for ocean carbon measurements within the framework of GCOS, highlighting the scientific priorities, observing system elements, existing and planned programmes, process studies, and technology development needed to implement such a system;
- Continue to develop international agreements on standards, best practices, certified reference materials, and data / metadata standards for ocean carbon;
- Expansion and maintenance of the international information centre for ocean carbon activities and plans that provides a central clearinghouse of information for observations and research;
- Continuation of the Watching Brief on ocean CO<sub>2</sub> sequestration and a regular international symposium on the Ocean in a High CO<sub>2</sub> World, designed to increase peer-reviewed literature for use by intergovernmental assessments, and to highlight issues of CO<sub>2</sub> pollution in the ocean for policymakers and the general public.

#### **I.2 Highlighted Results**

##### **Ocean Observations Panel for Climate**

The OOPC is supported by the IOC Secretariat, and cosponsored by GCOS, GOOS, and the WCRP. The OOPC has taken the lead in the drafting the ocean sections of the GCOS Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC (2AR), and its associated Implementation Plan (IP). The 2AR was presented to the UNFCCC Ninth Conference of the Parties (COP-9, December 2003, Milan), where it was accepted. COP-9 asked GCOS to develop a phased 5–10 year implementation plan (IP) for the integrated global observing systems for climate, where the OOPC again took the lead in the drafting of the ocean sections. The IP was presented to COP-10 (December 2004, Buenos Aires). These two documents provide a clear communication of the scientific recommendations for the sustained global ocean observing

networks for climate, along with recommendations for the necessary supporting systems. These include mechanisms for the free and timely exchange of data, and national agents for action specific for ocean observations.

### **International Ocean Carbon Coordination Project**

Since 2003, the IOCCP has implemented two workshops and co-sponsored a pCO<sub>2</sub> system intercomparison experiment. These activities have produced:

- An international communications centre for ocean carbon activities, including a web catalogue of information on ocean carbon observations and research, and quarterly email and web-based news bulletins;
- Compilations and synthesis of ocean carbon measurements from repeat hydrographic sections and ships of opportunity used for international field programme planning. This information exists as an on-line reference (maps and tables of up to date information on projects, data, and contact points) and are also available on CD;
- IOCCP recommended formats for pCO<sub>2</sub> Metadata and Data File Reporting from Underway Systems, IOCCP Recommended Practices for Data Exchange and Integration, and (joint with PICES) a “Guide of Best Practices for Oceanic CO<sub>2</sub> Measurement and Data Reporting” (to be published in early 2005).
- A Numerical Data Package technical report on underway pCO<sub>2</sub> systems, including best practices for ensuring accuracy and quantifying uncertainty of the systems (to be published by the Carbon Dioxide Information and Analysis Centre in early 2005).
- Observational strategies for repeat hydrography and ship of opportunity programmes, which are integrated into the strategy and implementation plans of the Global Climate Observing System in support of the UN Framework Convention on Climate Change.

### **The Ocean in a High CO<sub>2</sub> World**

Development and implementation of an international science symposium, May 2004, which addressed the biological and biogeochemical consequences of increasing atmospheric and oceanic CO<sub>2</sub> levels, and possible strategies for mitigating atmospheric increases. Over 120 scientists discussed topics ranging from ocean physics, to chemistry and biology, including the impacts of elevated CO<sub>2</sub> levels on marine life, the dissolution of calcium carbonate, and the impacts on coral reefs. Speakers also evaluated the possible benefits and impacts of surface fertilization and deep-ocean CO<sub>2</sub> injection strategies. Symposium participants did not address whether it would be a good policy choice to sequester carbon dioxide in the ocean, but did identify what scientific information is available, and what is still needed, to make informed policy decisions. Selected publications from this symposium include:

- IOC-SCOR Research Priorities Report (official report of the meeting; on CO<sub>2</sub> Panel site)
- Cicerone et al., The Ocean in a High CO<sub>2</sub> World, *Oceanography Magazine*, Vol 17, No. 3, September 2004, 72-78.
- Brewer et al., The Ocean in a High CO<sub>2</sub> World, *EOS Transactions*, Vol 85, No. 37, September 2004, 351-353.
- Hood, A Carbon Sink That Can No Longer Cope?, UNESCO — *A World of Science*, Vol 2, No. 4, October – December, 2004, 2-5.

- The Ocean in a High CO<sub>2</sub> World, *Journal of Geophysical Research – Oceans*; Special Issue (in preparation).
- Selected Media articles include: *New York Times*, July 20, 2004, Carbon Dioxide Extends Its Harmful Reach to Oceans; BBC News, August 17, 2004, Probe into Rising Ocean Acidity; *Financial Times*, 24 September 2004, Acid test for the marine web of life. (For a full listing of media articles from the symposium, see CO<sub>2</sub> Panel website.)

## **II. SCIENCE FOR OCEAN ECOSYSTEMS AND MARINE ENVIRONMENTAL PROTECTION (SOEMEP)**

### **II.1 Expected Results**

- A better understanding of the factors that regulate the dynamics of harmful algal blooms (HABs), in the context of ecosystems and human influences, to assist for improvement of capacities of the Member States for monitoring and prediction of HABs;
- Finalization of the primary start-up work on ecosystem indicators/indices for fisheries management;
- Further development of a) molecular, cellular, physiological, and community indicators of coral bleaching; b) indicators of the health of benthic communities;
- Further development of global and regional models to forecast the effects of nutrient inputs from water sheds to coastal marine ecosystems; and
- Facilitating international programs concerned with geosphere-biosphere coupling processes in relation to the protection of the marine environment of the high seas.

### **II.2 Highlighted Results**

#### **Harmful Algal Blooms (HABs)**

In 2003 the global research programme on the Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) published its Implementation Plan for adoption by MS and science community. Systematic enhancement of research and management capacity of harmful algae in Member States continued, including testing of innovative web-based learning tools. Individual training and study opportunities were provided to over 50 individuals in North Africa and for SE Asia. A new volume of “Manual on Harmful Marine Microalgae” was published in 2004, which provides guidelines to modern methods of sampling, identification, culturing, toxin analysis, monitoring and management of harmful marine microalgae. A joint Expert Consultation was established in 2004 with WHO and FAO to review the *Codex Alimentarius* Code of Practice for Marine Biotoxins. The review will revise the Code in early 2005. This will impact all national legislation on marine biotoxins and seafood safety.

#### **Indicators as Assessment tools**

IOC's start-up activities on **Quantitative ecosystem indicators for fisheries management** was carried out by an IOC–SCOR Working Group and finalized at a Symposium held at UNESCO in April 2004 (250 participants, 43 countries). Abstracts and the other relevant information were disseminated via a special web site with links to the IOC web site. A special issue of ICES journal is dedicated for publication (in 2005) of the papers presented.

IOC/GLOBEC Study Group on the use of **environmental indices in management of pelagic fish populations**, published its final report in 2003 (disseminated via web site). Several scientific papers have been published by peer-reviewed journals and a common database (*of upwelling indices, sea surface temperature and recruitment estimates linking environment and fisheries*) has been developed. These will be disseminated to general audience in 2005.

A workshop on regime shifts (in fish and other ecosystems) was held in April 2003 and results were published in March 2004 in a special issue of the journal *Progress in Oceanography*. Copies of the journal, which contains a synthesis, will be distributed to the Member States in 2005.

The ad hoc group called **Indicators for health of benthic communities** developed a database on benthic communities and pollution levels in 5 different regions. The group's work on sedimentary pollution vs. species richness has been published in preparation for publication in a peer-reviewed journal. The group held a joint workshop in Sardinia in October 2004 with EC researchers, and results are in-review for peer review publication. The group's work is disseminated through IOC web site.

IOC Group of Indicators for Coral Bleaching published several papers. The GEF WB Coral Reef Targeted Research & Capacity Building project (\$23M), which includes the IOC Group, was approved, with IOC and University of Queensland being designated as the Executing Agencies.

### **Assessments**

#### **Global NEWS (Global Nutrient Export from WaterSheds) Group**

Estimation of current and plausible future patterns of nutrient export to coastal ecosystems has begun. The group's work was successful in securing a GEF medium size (\$230K) project for training and raising public awareness. This Project is a part of larger GEF Project (\$1M), which also addresses an ecosystem approach to fisheries management, for which IOC is the Executive Agency.

#### **Ecosystem Models**

An IOC/SCOR Working Group was formed in 2003 on the topic of developing basin and global scale **models of marine ecosystems** and involved the integration of research results from several different Global programs including GLOBEC, JGOFS and WOCE. The Group published its results in *Science* in June 2004, which was disseminated at the 37th Executive Council.

#### **Geosphere-Biosphere Coupling Processes**

In IOC Programmes, **geosphere-biosphere coupling processes in relation to the protection of the marine environment of the high seas** is addressed through the Training-Through-Research Programme. This programme published in 2003–2004 nearly 30 papers in refereed journals (listed at IOC reports and web site) and in 2004 was successful in securing funds from the Belgian Government (US\$250.000) and the EU project Hermes (US\$100.000).

### **III. SCIENCE FOR INTEGRATED COASTAL AREA MANAGEMENT**

#### **III.1 Expected Results**

- Increased expertise and regional assessment for the characterization of watershed/coastal zones interactions (including coastline change, groundwater exchange in Coastal Zone, including nutrient transport, and the transport of both bed and suspended sediments);



- Further development of Global Web Service on Integrated Coastal Area Management acting as Clearing House Mechanism for global, regional, national information on ICAM
- Development of manuals, procedures, inventories, guidelines, which provide guidance to coastal scientists and managers and enable them to effectively contribute to Integrated Coastal Area Management;
- Development of guidelines on aggregated environmental-socio-economic indicators for ICAM, including evaluation indicators of ICAM programmes/project;
- Dissemination of a major global synthesis of how coupled physical-biological-chemical-sedimentary-ecosystem dynamical processes work in the coastal oceans, to improve the scientific basis for the management of coastal seas;
- Development of Regional Pilot project studies on interdisciplinary coastal processes (GEF Project – African Process);

### III.2 Highlighted Results

Following the **COAST II** Workshop (2001), the drafting and editorial process for the publication of two volumes of *The Sea* has been undertaken. Volume 13 on “Multi-Scale Interdisciplinary Processes” and volume 14 on “Interdisciplinary Regional Studies And Syntheses” provide a state-of-the-art assessment on interdisciplinary processes in the coastal oceans. The two Volumes of *The Sea* will be published by Harvard University Press in early 2005. A set number of copies will be disseminated to Member States.

The IOC-NOAA-DFO Project on the use of **Indicators for Integrated Coastal Area Management** was initiated following the international workshop held in Ottawa in 2003. A **Reference Guide on the Use of Indicators for ICAM** (IOC Manuals and Guides, 42) was published in 2003 by IOC, and provides a survey of practices for assessing coastal management programmes. A Special Issue on Indicators was published in the *Ocean and Coastal Management Journal* (Elsevier) in 2003. In 2004, editorial work started for the development of a “Handbook on the application of Indicators in ICAM” which is expected to be published in 2005 together with a volume on case studies.

The joint **IOC/IHP/IAEA Project on Submarine Groundwater Discharge (SGD) in the Coastal Zone** is continuing its intercalibration work and field experimentations. So far four international experiments have taken place in various geological environment, in Sicily, Australia, USA, Brazil and the fifth one will take place in Mauritius in March 2005. A Guide on SGD was published by IOC/IHP in 2004. More than 20 scientific papers on the IOC/IHP/IAEA Project have been published in various journals including *Continental Shelf Research Journal*, *Biogeosciences*, *EOS*, *Biogeochemistry*, *Hydrological Processes*, *Journal of the Total Environment*, *Journal of Environmental Radioactivity*.

As a follow-up to PACSICOM and the African Process, IOC has led the development of a **project proposal on climate change adaptation in coastal zones and shoreline change management through ICAM** in West Africa. In 2003, this project was endorsed by the NEPAD Partnership Conference on Environment as a direct contribution to the NEPAD Environment Action Plan. The project has been accepted to pipeline entry as a PDF-B project and will be funded up to 1 Million US\$ (GEF-\$750k, co-financing: \$250K). IOC will be the executing agency of this project, which is expected to start in March 2005.

In a drive to improve the delivery of useful ocean data products and services for the coastal management community at the national and regional level, ICAM has taken a major part in the development of the **ODINAFRICA-III** project, which was approved by the Government of Flanders, Belgium, in 2003. As Workpackage 4 of ODINAFRICA, ICAM is organizing national consultations in the participating countries to identify stakeholder needs, as well as the development of targeted products, including training for Coastal GIS, development of state of the coast reports, vulnerability mapping activities, etc.

### **Selected Publication Highlights from Ocean Science Section Programmes**

- Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the United Nations Framework Convention on Climate Change, *GCOS 82, WMO/TD No. 1143*, April 2003.
- Dickson, A., Guide of Best Practices for Oceanic CO<sub>2</sub> Measurement and Data Reporting, PICES – IOC, *in preparation*, 2004.
- Cicerone et al., The Ocean in a High CO<sub>2</sub> World, *Oceanography Magazine*, Vol 17, No. 3, September 2004, 72-78.
- Brewer et al., The Ocean in a High CO<sub>2</sub> World, *EOS Transactions*, Vol 85, No. 37, September 2004, 351-353.
- The Ocean in a High CO<sub>2</sub> World, *Journal of Geophysical Research – Oceans; Special Issue (in preparation)*.
- IOC Ocean Carbon in the World's News Media: Carbon Dioxide Extends Its Harmful Reach to Oceans, *New York Times*, July 20, 2004; Probe into Rising Ocean Acidity, *BBC News*, August 17, 2004; Acid test for the marine web of life, *Financial Times*, 24 September 2004.
- Environmental, habitat area and biomass effects on surplus production in California sardine (*Sardinops sagax*), Larry D. Jacobson, Steven J. Bograd, Richard J. Parrish, Roy Global Ecology and Oceanography of Harmful Algal Blooms, Scientific Implementation Plan, 2003.
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- Harmful Algae Management and Mitigation. 2004. Hall, S., Etheridge, S., Anderson, D., Kleindienst, J., Zhu, M., and Zou, Y. (Eds) Asia-Pacific Economic Cooperation (Singapore): APEC Publication #204-MR-04.2
- Harmful Algal Blooms in the Caribbean. In 'Revista de Biologica Tropical', Vol. 52 (Supl.1), Costa Rica, 2004.
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- Peer reviewed articles on Environmental Indices in Management of Pelagic Fish Populations: Long-term changes in fish abundance and environmental indices in the Black Sea. Daskalov, G., *Mar. Ecol. Prog. Ser.* 255: 259-270, 2003.
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- Limits to the use of environmental indices to reduce risk and/or increase yield in the South African anchovy fishery, De Oliveira, J.A.A. and D.S. Butterworth. *African Journal of Marine Science*, 27: 2005.(In press).
- Regime Shifts, R.P. Harris and J.H. Steele (Ed). special issue – *Progress in Oceanography*, Vol. 60, Nos. 2-4, 2004.
- Organic Carbon Content of Sediments as an Indicator of Stress in the Marine Benthos, .J. Hyland, Balthis, L. , Karakassis, I., Magni, P., Petrov, A., Shine, J., Vestergaard, O., and Warwick, R., *Mar. Ecol. Prog. Ser.* 2004 (in press).
- Experimental Biology of Coral Reefs, Micheal P. Lesser, *J Exper. Mar. Biol. And Eco.*, 300, 217-252, 2004.
- Low symbiont diversity in Southern Great Barrier corals relative to those of the Caribbean, La Jeunesse et al., *Limnology and Oceanography*, Vol. 48(5), 2003.
- Status of Coral Reefs of the World: 2004*, Global Coral Reef Monitoring Network, 2004.
- Challenges of modeling Ocean Basin Ecosystems, Brad deYoung et al., *Science*, Vol. 304, 2004.
- Surveying the flanks of the Mid-Atlantic Ridge: the Atlantic Basin, North Atlantic Ocean (36° N), Alves T.M., Cunha T., Bouriak S. et al., *Marine Geology* (2004), **209**, 199-222.
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- IOC Manual and Guide 44: SGD: Management implications, measurements and effects, UNESCO 2004.