

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH



*SCOR
Proceedings
Vol. 40*

*Venice, Italy
September 2004*

INTERNATIONAL COUNCIL FOR SCIENCE

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ISSN 0253-2808

INTERNATIONAL COUNCIL FOR SCIENCE

**PROCEEDINGS
OF THE
SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH**

July 2005
Baltimore, MD, USA

Support for SCOR activities in 2003-2004 came from the membership contributions of national committees and from the following organizations and agencies:

Alfred P. Sloan Foundation
Intergovernmental Oceanographic Commission of UNESCO
International Geosphere-Biosphere Programme
Minerals Management Service (USA)
National Aeronautics and Space Administration (USA)
National Oceanic and Atmospheric Administration (USA)
 National Marine Fisheries Service
 National Ocean Service
National Science Foundation (USA)
 Division of Ocean Sciences
 Office of Polar Programs
Natural Environment Research Council (UK)
Research Council of Norway
United Nations Educational, Scientific and Cultural Organization
University of Plymouth (UK)

Additional copies of this publication are available from:

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This report is available in pdf format at <http://www.jhu.edu/scor>.

SCOR Proceedings, Volume 40
REPORT OF THE XXVIIth SCOR GENERAL MEETING

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XXVIIth SCOR GENERAL MEETING

Consiglio Nazionale delle Ricerche

Venice, Italy

27-30 September 2004

1.0 OPENING

1.1 Opening Remarks and Administrative Arrangements

The SCOR President, Robert Duce, welcomed meeting participants (see Annex 1) and introduced Roberto Purini, a SCOR Vice-President from Italy. Purini welcomed everyone to the Institute of Marine Science of the Italian National Research Council (Consiglio Nazionale delle Ricerche-CNR) on behalf of the Institute Director, Enrico Bonatti. Many things have changed in Italy since the last SCOR annual meeting in this country in 1966. There has been a major reorganization of science in Italy in the past five years, especially within CNR. Purini especially thanked Mrs. Jane Frankenfield Zanin, who was responsible for local logistics for the meeting. Purini introduced Mauro Sclavo, head of the research section in Venice, who welcomed meeting participants and said that SCOR's meeting here again was a sign of goodwill to the entire Italian oceanographic community. Sclavo reviewed the local arrangements and wished all a good meeting. Duce thanked the Italian hosts in advance for the arrangements for the four-day meeting and asked participants to introduce themselves.

1.2 Approval of the Agenda

The agenda was modified from the usual order to make it possible for some participants from the SCOR Project Coordination Meeting the previous week to hear presentations of the large-scale research projects on Monday, and to make it possible for the International Geosphere-Biosphere Programme (IGBP) President, Guy Brasseur, to make a presentation about IGBP (see Annex 2).

1.3 Report of the SCOR President

Robert Duce briefly reviewed activities since the 37th Executive Committee Meeting in September 2003 in Moscow. Duce has had daily-to-weekly interactions with the SCOR Executive Director, Ed Urban. SCOR's financial condition is good now and SCOR has funds to begin new activities, such as working groups. Duce stated his excitement about the development of new programs in which SCOR is involved. SCOR continues its excellent partnership with IGBP and the Intergovernmental Oceanographic Commission (IOC) in the Global Ocean Ecosystem Dynamics (GLOBEC) project. The Surface Ocean – Lower Atmosphere Study (SOLAS) *Science Plan and Implementation Strategy* has been approved by all four co-sponsors (SCOR, IGBP, the World Climate Research Programme [WCRP] and the Commission on

Atmospheric Chemistry and Global Pollution [CACGP]) and was published early in 2004. SOLAS has its first open science meeting in October 2004 to present results of SOLAS research. The Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project *Science Plan and Implementation Strategy* is moving along well, and has been approved in principle by SCOR and IGBP, subject to response to reviewers' comments. The GEOTRACES project on biogeochemical cycles of ocean trace elements and isotopes is developing well with SCOR support.

The United Nations is developing a Global Marine Assessment (GMA), like an oceanic International Panel on Climate Change (IPCC) assessment. Duce represented SCOR and its parent, the International Council for Science (ICSU) in the GMA planning process. Political factors have slowed the GMA development process.

Last year SCOR was reviewed by ICSU, with an excellent outcome (see 2003 *SCOR Proceedings*). This outcome was rewarding and resulted from efforts of SCOR volunteers and staff over SCOR's history, as well as good SCOR contribution to the assessment.

The International Association for the Physical Sciences of the Oceans (IAPSO), Scientific Committee on Problems of the Environment (SCOPE), and SCOR have been discussing activities related to semi-enclosed seas. The IGBP/SCOR fast-track meeting on the global iron cycle will result in one review paper in *Science*¹ and as many as three more-specific papers in *Global Biogeochemical Cycles*. The SCOR/IOC Symposium on the Ocean in a High-CO₂ World—initiated by SCOR and funded primarily through grants to SCOR—in Paris in May was very successful. This symposium was chaired by Ralph Cicerone, the next president of the U.S. National Academy of Sciences. The meeting was broadened by the planning committee from the original SCOR idea of a focus on carbon sequestration science. There will be a special section of peer-reviewed papers published in the *Journal of Geophysical Research—Oceans* and meeting reports published in *EOS*² and *Oceanography Magazine*³. Duce and Urban attended the IOC Assembly in June. Duce ended his comments by noting that this is his final meeting as SCOR President and he has enjoyed his term tremendously.

1.4 Report of SCOR Executive Director

Ed Urban added his welcome to others made previously. He noted that he hopes that the large meeting book is a reference resource. In 2003, SCOR reached a historic high level in income (US\$1,169,551). 2004 dues payments are well on track. As stated in previous years, Urban is concerned at the level of SCOR's dependence on U.S. funding and seeks help from national

¹Jickells, T.D. et al. 2005. Global iron connections between desert dust, ocean biogeochemistry, and climate. *Science* 308:67-71.

²Cicerone et al. 2004. The Ocean in a High CO₂ World. *EOS* 85:351, 353.

³Cicerone et al. 2004. The Ocean in a High-CO₂ World. *Oceanography Magazine* 17(3):72-78.

SCOR committees in raising funds for SCOR activities. The new SCOR poster has been printed and an A0 version was posted outside the meeting room. Urban thanked Julie Hall for her work on the poster. SCOR was incorporated in 2004 at the request of ICSU. Eight SCOR working groups met since the 2003 SCOR meeting in Moscow. Urban noted that it is good that these groups are moving along and completing their work in a timely manner. The new projects sponsored or co-sponsored by SCOR have made good progress this year. SCOR was able to facilitate two inter-project meetings in the past year, on project data management and a broader Project Coordination Meeting among a greater range of marine research projects, last week in Mestre, near Venice. An important aspect of the Symposium on the Ocean in a High-CO₂ World is that many scientists who attended were not previously aware of the magnitude of the problem of ocean acidification. In terms of staffing, the SCOR Secretariat managed without an administration assistant for 14 months in 2002 and 2003. The half-time Administrative Assistant (Phyllis Steiner) hired in November 2003 is doing an excellent job.

1.5 Appointment of an *ad hoc* Finance Committee

Robert Duce reported that Birger Larsen (Denmark) will chair the *ad hoc* Finance Committee during the meeting. Marie-Alexandrine Sicre (France) and Victor Akulichev (Russia) will be other members. The committee will report back during the final day of the meeting.

1.6 Committee to Review the Disciplinary Balance of SCOR's Activities

John Field reported that the members of the disciplinary balance committee have been maintained since the 2001 meeting (John Field, Laurent Labeyrie, and Roberto Purini). There was a report later in the meeting (see Section 8.6) about the disciplinary balance of SCOR activities.

2.0 WORKING GROUPS

2.1 Disbanded Working Groups

2.1.1 WG 93—Pelagic Biogeography

Annelies Pierrot-Bults reported at the 2002 General Meeting that the English version of biogeography terms was ready to publish, and Spanish terms were to be published soon. Since that time the English-Spanish document was posted on the SCOR Web site (<http://www.jhu.edu/scor/Biogeography.doc>). It includes English definitions, with Spanish translations of the terms and a Spanish cross-reference list of terms. Pierrot-Bults appealed for volunteers to do translations of the terms into other languages.

2.1.2 WG 107—Improved Global Bathymetry

Laurent Labeyrie reported that the group's report was published in the *IOC Manuals and Guides* series in 2002, soon after the SCOR General Meeting and the group was disbanded. The Executive Committee requested that the WG chair produce (or commission) a summary of the report for publication as an *EOS* article. A follow-up letter to agencies holding bathymetric data was to be prepared and other actions were considered at the Moscow meeting. These actions have not been completed. Labeyrie suggested that the matter should be laid to rest, since the work will go on, and there is not much that SCOR can add at this point. Colin Summerhayes, chair of the working group, added that its report was well received by the General Bathymetric Chart of the Oceans (GEBCO) committee, and it has been distributed to the mapping community. He does agree that there is a need to distill the report and recommendations for an *EOS*-type article. Summerhayes will work with Labeyrie to follow up.

2.1.3 WG 112—Magnitude of Submarine Groundwater Discharge and its Influence on Coastal Oceanographic Processes

Robert Duce reported that the product of this working group included a special issue of the journal *Biogeochemistry* (published in 2003) and a chapter in the synthesis book for the Land-Ocean Interactions in the Coastal Zone (LOICZ) project (still in progress). The group was disbanded and thanked for their service.

2.1.4 WG 113—Evolution of the Asian Monsoon in Marine Records: Comparison Between Indian and East Asian Subsystems

Working group members participated in Ocean Drilling Program and IMAGES cruises designed to investigate the evolution of the Asian monsoons over past million years. Laurent Labeyrie reported that *Marine Geology* published a special volume of the papers contributed to the working group's second workshop in 2003. A review paper is being prepared based on the results of the first and third workshops, to be published in *Quaternary Science Reviews*.⁴ The group members were thanked for their service and the group was disbanded.

A new working group may be proposed in the next two to three years, dealing with monsoons and global change.

2.1.5 WG 118—New Technologies for Observing Marine Life

Annelies Pierrot-Bults reported that the WG 118 Web site was re-designed (see <http://www.coml.org/scor/scor.htm>) as the product of the working group and as a resource for the new Panel on New Technologies for Observing Marine Life (see Section 4.3.5). WG 118 was disbanded and group members were thanked for their service.

⁴Wang, P. et al. 2005. Evolution and variability of the Asian monsoon system: State of the art and outstanding issues. *Quaternary Science Reviews* 24:595-629.

2.2 Current Working Groups

The Executive Committee Reporter for each working group presented an update on working group activities and progress, and made recommendations on actions to be taken. (In some cases, the working group chair also presented comments.) The meeting made recommendations, based on the progress of working groups and the merits of the requests, about whether funding should be provided for 2005 activities of working groups that requested funds. The Finance Committee took into account the recommendations of the meeting as it developed the 2005 SCOR budget, which was approved by meeting participants.

2.2.1 WG 109—Biogeochemistry of Iron in Seawater

Robert Duce reported that this joint group with the International Union for Pure and Applied Chemistry (IUPAC) produced a book in 2001. A subgroup on iron standards was set up at the Amsterdam General Meeting (1998) and met at the 2000 Ocean Sciences Meeting in San Antonio, Texas; an intercalibration of standards was underway at the time of the 2000 SCOR General Meeting. The subgroup met in late 2002 to discuss the results of the intercomparison. The results of this intercomparison led (in part) to a grant from NSF for a larger intercomparison cruise following the SCOR activity. Hein de Baar reported that there has been a paper submitted to *Marine Chemistry* from the first exercise. It was agreed to disband this working group.

2.2.2 WG 111—Coupling Winds, Waves and Currents in Coastal Models

Ilana Wainer reported that this working group is developing a book tentatively entitled *Coupled Coastal Wind-Wave-Current Dynamics*, which will be published by Cambridge University Press in 2005. Peter Craig (Australia) is leading the editorial work for the book. The group's activities are funded by the U.S. Minerals Management Service and National Aeronautics and Space Administration.

2.2.3 WG 114—Transport and Reaction in Permeable Marine Sediments

Laurent Labeyrie reported that the 2003 Executive Committee meeting gave permission for the group to remain dormant until 2006, so that they could serve as an organizing committee for the next Gordon Research Conference on this topic. They were also requested to produce a volume of seminal papers in the field, accompanied by a significant synthesis paper. Although the working group suggested this idea, they have lost interest in it. Labeyrie noted that he is not happy to disband the group without any product at all. Carlo Heip (Belgium) reported that many of the members of this group are involved in a big European Union program on the same topic. Bjørn Sundby, an Associate Member of the group, believes that the group has become superfluous, since the work is progressing well without SCOR's additional help. They have established a new Gordon Research Conference (GRC) series. Sundby suggested that the group be disbanded, since it has lost interest in producing a product beyond the GRC.

Ed Urban noted that this brings up a policy issue for SCOR: Is a GRC an acceptable product since no publication is allowed under GRC rules? Duce replied that in future it must be made clear that a publication is also expected as another product, if a working group convenes a GRC as one of its products. It was agreed to disband WG 114.

2.2.4 WG 115—Standards for the Survey and Analysis of Plankton

Annelies Pierrot-Bults reported that this working group has been very active. It met for the second time in Concepción, Chile in November 2003, including an extra day to meet with South American plankton scientists, made possible through a small amount of SCOR support from its travel grant for developing country scientists. This was a good use of SCOR funds to spread knowledge of plankton techniques within South America. Song Sun (China-Beijing) was added as a Full Member of the working group, and Erika Head (Canada) and Juha Flinkman (Finland) were added as Associate Members in 2003. The group plans to meet for its third and final time, with a symposium, in 2006. The Web site is being hosted at the Sir Alistar Hardy Foundation for Ocean Sciences (SAHFOS). The group has good information on each of the big monitoring programs. The working group is concerned about how to maintain their Web site after the group has finished its work. Ed Urban will follow up on this issue.

2.2.5 WG 116—Sediment Traps and ²³⁴Th Methods for Carbon Export Flux Determination

Laurent Labeyrie reported that the group met in November 2003 to construct the outline for a special journal issue on their topic and held a meeting in August 2004 to coincide with a larger meeting on this topic in the United States. (Some of the costs of the meeting were paid as part of the larger meeting.) The group has requested funding for a final meeting in 2005 and will submit their work for a special issue of *Progress in Oceanography*.

2.2.6 WG 119—Quantitative Ecosystems Indicators for Fisheries Management

John Field (South Africa) reported that the working group convened a large symposium at UNESCO in Paris on March 31-April 3, 2004. About 250 individuals participated and about 200 posters were presented. The symposium was funded by IOC, the U.S. National Marine Fisheries Service, FAO, PICES, several French agencies, and GLOBEC. PICES handled the registration process for the meeting. A special issue of the *ICES Journal of Marine Science* will be produced from the symposium.⁵ Field added that this was the right topic at the right time and should be considered one of SCOR's success stories. SCOR started WG 119 around the same time that the World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa called for nations to adopt ecosystem approaches to fisheries. Field reviewed the topics of the group's "task forces." The symposium was a great academic success, although there was some cynicism from managers related to practicality of ecosystem indicators since their use would take a decade to show results. The use of species-level management methods shows immediate results for managers, but are not the best way to manage fish stocks. SCOR will receive a final report next year with reports of the task forces. In terms of follow up to the symposium and its publication, Field stated that the working group felt there would be more discussions needed about how to implement ecosystem management, but perhaps the UN Food and Agriculture Organization (FAO) will take this up, rather than SCOR, since the intergovernmental bodies are the ones with "teeth" to enforce recommendations. Field recommended that the working group be extended to

⁵ Daan et al, 2005. Quantitative Ecosystem Indicators for Fisheries Management. *ICES Journal of Marine Science* 62:307-613.

the 2005 SCOR Executive Committee meeting, to clarify what more might be needed. There is a need to develop a management framework for applying indicators.

2.2.7 WG 120—Marine Phytoplankton and Global Climate Regulation: The *Phaeocystis* Species Cluster As Model

Julie Hall reported that the working group's second meeting was held in Savannah, Georgia, USA in December 2003. The group would like to convene a GRC-type meeting in September 2005 to gather information for their final product, which will be a special journal issue with 11 papers. Hall added that there is a Web site set up in The Netherlands for the conference (see calendar on SCOR Web site). Flyers are nearly ready for the conference. Hall recommended that developing country travel funds be given to the conference, even though they had not requested funds. SCOR approved this allocation of travel funds, pending renewal of SCOR's travel grant from NSF. This working group is linked to the SOLAS project by a member of the SOLAS Scientific Steering (SSC) (Christiane Lancelot) serving on the working group.

2.2.8 WG 121—Ocean Mixing

Roberto Purini reported that SCOR and IAPSO co-submitted proposals to NSF and the U.S. Office of Naval Research and received \$40,000 from these two sources for the group's symposium scheduled for October 2004 in Victoria, B.C., Canada. Waldemar Walczowski (Poland) and Fangli Qiao (China-Beijing) were added as Associate Members, at the request of their national SCOR committees. The symposium will result in a special issue of *Deep-Sea Research*. Paola Rizzoli (IAPSO) noted that she thinks this is one of the best SCOR working groups in the field of physical oceanography. Although the name of the group was changed from "Deep Ocean Mixing" to "Ocean Mixing" there is some uncertainty about whether the term "deep ocean" should still appear in the group's terms of reference. Ed Urban was asked to clarify this with the working group chair, Robin Muench.

2.2.9 WG 122—Mechanisms of Sediment Retention in Estuaries

Laurent Labeyrie reported that the group held its first meeting in Faro, Portugal in September 2004. The group's second meeting will be held in June 2005 in The Netherlands in conjunction with the LOICZ II Open Science Meeting. The group's final meeting will be in 2006 in Louisiana or Texas. Marek Zajaczkowski (Poland) was added as an Associate Member in 2004. This group is cosponsored by LOICZ and IAPSO. It is working on a Web site (see <http://www.criba.edu.ar/scorwg122/>). Labeyrie stated that he thinks the group is making good progress now, making up for the delay in getting its terms of reference settled.

2.2.10 WG 123—Reconstruction of Past Ocean Circulation (PACE)

Ilana Wainer reported that this group has very ambitious plans, focused on identifying proxies that could be used to study whether and how ocean circulation is sensitive to rapid climate change. Several group members held an opportunistic meeting in conjunction with the European Geophysical Union (EGU) meeting in April 2004. They are proposing to hold a conference on their topic in Atlanta, Georgia, USA in March 2005, bringing together physical oceanographers and paleoceanographers. Laurent Labeyrie added that there are many problems in using proxies,

such as sensitivity and varying fluxes. The role of this working group is to establish good proxies for studying past ocean circulation; this is why the link to IMAGES is important. At the group's first meeting various tools were reviewed and the problems of quantification associated with each was discussed. Michael MacCracken (IAMAS) asked if there is any chance that the group could go back another 20,000 years to pick up the new information about Greenland ice cap melting 17,000 years ago. Labeyrie responded that the last interglacial is very interesting, but this working group is focused on methods and proxies and its scope should not be increased.

2.2.11 WG 124— Analyzing the Links Between Present Oceanic Processes and Paleo-Records (LINKS)

Ilana Wainer reported that this group held a planning meeting in conjunction with the 8th International Conference on Paleoceanography in September 2004 in Biarritz, France. Marie-Alexandrine Sicre, one of the two co-chairs of the group, added that all working group members were present. They identified 5 or 6 factors or sub-topics to consider by one to three members each, to produce draft documents. The focus of the group's first year of work will be to determine how well we understand the evidence of existing ecosystems in proxies and how proxies could be used in combination to increase understanding. Karin Lochte (Germany), the other co-chair, is developing a Web site for use by the group. They will develop an article for *EOS* and are planning a special session at the 2005 Fall AGU meeting and a conference in 2006, with a final working group meeting in 2007.

2.3 New Working Group Proposals

Three working group proposals were received by the SCOR Secretariat. SCOR can fund two new working groups to begin in 2005.

2.3.1 Working Group on Global Comparisons of Zooplankton Time Series (see Annex 3)

Annelies Pierrot-Bults was the monitor for this proposal. She reported that 17 comments were received on the proposal from individuals and national SCOR committees. Before discussing the comments, Pierrot-Bults turned over the discussion to David Mackas, one of the proponents, to make a presentation of the proposal. Following the Mackas presentation, meeting participants discussed the proposal. The proposed working group would basically do for zooplankton what SCOR WG 98 on Worldwide Large-scale Fluctuations of Sardine and Anchovy Populations did for fish.

Akira Taniguchi (Japan) endorsed the proposal because fluctuations or oscillations in zooplankton populations are usually very subtle (compared to size of fluctuations in fish stocks) and in order to detect them we need very precise information from extensive data sets. Paola Rizzoli stated that IAPSO supports this proposal and gives it a very high ranking. The topic is very timely and is a priority for ocean sciences. The terms of reference and membership are very biologically oriented, however, and IAPSO would like to see physical oceanography included. IAPSO will cosponsor the group if physical oceanography is adequately added.

Manuel Barange (GLOBEC) stated that GLOBEC strongly supports this proposal, based on a discussion at their SSC meeting in April 2004. The proposed focus of the group is relevant to many GLOBEC field programs and brings together a lot of GLOBEC research. GLOBEC will sponsor an Associate Member and agreed to help bridge the gap with physical oceanographers. The proposed working group is similar to SCOR/IOC Working Group 119 on Quantitative Ecosystem Indicators for Fisheries Management because it would provide a more synthetic view of ecosystems. Alex Bychkov (PICES) reported that PICES strongly supports the proposal and would support one Associate Member from the Pacific region.

John Field reported that the South African SCOR committee strongly supports this proposal. It is timely and they agree with GLOBEC on the importance of this group. It also has positive long-term implications for the Global Ocean Observing System (GOOS). The South African committee suggested addition of an Associate Member with Southern Ocean expertise. Peter Burkill (UK) reported that the UK SCOR Committee strongly supports the proposal. It is excellent to see the strong links of the proposed activity to PICES and GLOBEC. Burkill asked if the links with large marine ecosystem (LME) studies are developed well enough in the proposal? Will the working group help to ensure that the plankton data sets are more easily available in the public domain? Mackas responded that there are two ways to get people to turn in data: (1) make it a condition of funding (e.g., the approach used successfully in the United States) and/or (2) make it obvious to the investigators that this is a good thing to do.

Jorma Kuparinen reported that the Finnish SCOR Committee supports the proposal also. He also asked whether inland waters would be included; for example, long time series are available for the Baltic Sea and might show some strong influences on processes in these data sets due to long-term changes occurring in the drainage basin. Mackas replied that he hopes that ICES might bring that topic in by sponsoring an Associate Member of the working group. Bjørn Sundby stated that the Canadian National Committee for SCOR endorses this proposal and even paid for Mackas to come to the meeting to present it. Hein de Baar stated that The Netherlands SCOR Committee is very enthusiastic about the working group, although they had some questions about the final product and whether it would be easily available. Mackas responded that the product will be a publication and a prototype database. François Ronday (Belgium) stated that the Belgian SCOR Committee agreed that the working group would benefit from adding another Full Member from physical oceanography, with a link to the IAPSO community. Mingyuan Zhu (China-Beijing) stated that the Chinese SCOR Committee supports the proposal. He suggested that the working group could also consider impacts of humans in addition to climate change. China has long-term zooplankton monitoring data available that could be useful for this project. Birger Larsen stated that the Danish SCOR Committee also supports the proposal and asked whether it should include paleo-information. Mackas replied that he is aware of good paleo-records for fish, but not for zooplankton, except possibly for pteropods. Jeandel stated that the French SCOR Committee also supports the proposal. She reinforced the message of IAPSO about the need for adding a physical oceanographer. Emilio Fernandez (Spain) stated that the Spanish SCOR Committee also approves the proposal, with similar comments as the other national committees. He asked if the proposal is a little too focused on technical aspects, and not

enough on interpretation of results. He has provided information to SCOR on data sets available in Spain and provided the name of a young Spanish scientist for the working group.

Ilana Wainer agreed on the need for a physical oceanographer on the working group to help interpret and apply the group's results. She asked about the plans for input from South America. Mackas replied that they will begin with the longest time series, which are primarily available from areas of the Northern Hemisphere, but do include a long time series from the Peru-Chile Current system. As they find interesting patterns, they will look for new time series to test them. Alan Sielen stated that the U.S. SCOR Committee has two comments on the proposal, related to (1) the terms of reference and (2) archiving data sets. Establishing the archive may be too ambitious a task and the working group should probably stop at making recommendations about how to establish an archive. Satellite observations might provide additional data. The working group should establish links to the Ocean Biogeographic Information System (OBIS). Is it true that absolute abundance of zooplankton is not included in databases and therefore we can't study spatial variability? Can the working group use its leverage to encourage creation of new plankton data sets? Duce added that the U.S. SCOR Committee feels that there are too many U.S. members on the proposed group; there are four out of 10 in the proposal. Regarding links to OBIS, Pierrot-Bults noted the proposed work doesn't go to the species level, they work on abundance. It will also be important to get information on life stages and qualitative data. IABO supports the proposal. Pierrot-Bults added that this proposal overlaps a little with WG 115 on Standards for the Survey and Analysis of Plankton, although there is a connection through one member (Hans Verheye). Ron O'Dor added that the new CoML project Census of Marine Zooplankton (CMarZ) will be complementary to this working group.

2.3.2 Working Group to Investigate the Role of Viruses in Marine Ecosystems (see Annex 4)

Julie Hall, the Executive Committee monitor for this proposal, stated that it is important to understand the role of viruses in carbon and nutrient cycles, marine diversity, and marine ecosystem function. Viral lysis is one of the main factors controlling phytoplankton abundance. Hall reviewed the proposed terms of reference. The activity will culminate in a symposium and special journal issue. Hall stated that she thought the terms of reference are appropriate, with firm products. They want to convene their first meeting in association with the American Society of Limnology and Oceanography (ASLO) meeting in Spain in 2005, their 2nd meeting in 2006, and an international symposium in 2008; for the latter, they are already working on arranging funding. Various comments were made about the proposed working group membership, particularly that all proposed members are from the Northern Hemisphere. Hall responded that the proponents had left two spots open for scientists from developing countries. In general the proposal was viewed as timely and important and was ranked by responding national SCOR committees as 1st or 2nd of the three proposals considered this year.

Ilana Wainer will provide other names from Brazil and suggested that the group perhaps needs a physical oceanographer as an Associate Member. The topic is new science and the Brazilian SCOR Committee supports it. Bjørn Sundby asked if there is a clear need for this working group

and whether it is likely to have a significant positive impact. SCOR always needs to ask what would not be accomplished if a working group or other activity is not approved. Is this group parallel to WG 114 on Permeable Marine Sediments, which was approved at the beginning of a developing field, but ran out of momentum? Is SCOR involvement really needed? He thinks not, although a case could be made for forming a working group if it would benefit SCOR. Sundby added that the proposal gives only “lip service” to helping developing countries, but this issue is not addressed in the terms of reference. Huasheng Hong (China-Beijing) stated that there is viral research going on in her lab and she has a good young Chinese scientist to suggest as a member. Hein de Baar stated that The Netherlands SCOR Committee was very enthusiastic about the proposal, taking into account the issues already mentioned regarding membership. de Baar also emphasized the desirability of approving at least two new working groups each year, as a general SCOR policy.

Laurent Labeyrie is not sure Sundby’s comment is relevant to this proposal. SCOR can help with bringing things together in this field, but we must make sure the terms of reference are precisely defined. Catherine Jeandel stated that the French SCOR Committee strongly supports the proposal, particularly related to exchanging samples. She suggested a new member from the UK, but recognizes the need for the proposed membership not to be entirely from the Northern Hemisphere. Peter Burkill added that the UK SCOR Committee supports the proposal as a “hot” topic. Some of the proposed activities would be done anyway, but he still thinks SCOR should be involved. The UK SCOR Committee is also concerned about the membership. Paola Rizzoli stated that IAPSO is only moderately supportive of the proposal because it is purely biological. Sielen mentioned that the U.S. SCOR Committee noted the membership problems and requests that a more tangible deliverable be specified. The proposal needs more technical justification. The U.S. SCOR Committee questions the feasibility of data going into a Web site. John Field stated that the South African SCOR Committee supports the proposal, but slightly less than the zooplankton proposal. The South African committee has a membership suggestion of a South African currently doing a post-doctoral fellowship in the UK. Ron O’Dor noted that the new CoML activity, International Census of Marine Microbes (ICoMM), could be relevant to this working group. Robert Duce stated that waiting to identify members and terms of reference until the first meeting is not the normal SCOR procedure. Hall agreed; much of this should be done before the first meeting and the time frame should be shortened.

2.2.3 Working Group on the Presence and Abundance of *Benthosema pterotum* Myctophid Fish in the Northern Arabian Sea

Akira Taniguchi, the SCOR monitor for this proposal, stated that he reviewed all comments received on this proposal. All were negative in terms of SCOR approval this year, due to the limited target species in a limited area, with very limited membership. However, the proposal perhaps could be raised to an acceptable level. We need precise knowledge about mesopelagic stocks due to increased interest in harvesting them. This proposal should be expanded to a global proposal and undertaken by an organization like FAO. SCOR could contribute membership to such a study.

Hein de Baar stated that this proposal offers an opportunity to bring in new scientists and countries to SCOR. The NW Indian Ocean is an important area. But, Netherlands SCOR members think the proponents need help to develop the proposal into a form acceptable to SCOR. Taxonomically, the proposal is too narrow; it should include more species of myctophid fish and include other regions. Catherine Jeandel stated that the French SCOR Committee agrees that we need to send the proponents a positive message. She noted that most of the references in the bibliography are Norwegian, so they should get Norwegian scientists involved. Colin Summerhayes stated that the proposal seems more like an IOC proposal and asked whether SCOR is the right forum. Peter Burkill stated that he is delighted to see a proposal from outside the developed world. But, it does need to be broadened and Burkill had several suggestions for new directions. Paola Rizzoli stated that this proposal covers just a local study of one species, related to field studies made in the 1970s and 1980s. IAPSO does not think it should be approved, but that SCOR should send the proponents a positive message.

Ilana Wainer agreed with the previous comments, including the need to encourage the proponents to revise the proposal. Birger Larsen agreed that the proposal is too narrow and too regional, and that it should be revised. Alan Sielen reported that the U.S. SCOR Committee also noted the narrow geographic focus. If the proposal is resubmitted, the terms of reference need to be clarified and there should be identification of sources of funding for the proposed surveys. François Ronday made similar comments and queried how best to send a positive message to the proponents. They should be given information on how to prepare a proposal, over the next year. Ron O'Dor added that the CoML mid-Atlantic ridge project has just had a successful cruise with very good results on mesopelagic fish. The investigators would like to get the *G.O. Sars* into other areas; perhaps they could connect to this working group, if it is eventually approved. Alex Bychkov added that PICES is sponsoring a micronekton intercalibration experiment, which is related to this working group. Robert Duce summarized that this proposal seems to be rated at third among the three working group proposals, but that SCOR needs to encourage the proponents. The Executive Committee will discuss this action and will attempt to develop general guidelines for when this situation arises again. Hein de Baar asked whether names could be identified who would be interested in this project in other regions to help them. Duce asked participants to contribute names to Ed Urban.

Robert Duce stated that this proposal raises the important issue of regional working groups. SCOR has not traditionally supported regional working groups, although SCOR has received a number of such proposals in previous years. They usually come from developing countries, and we want to work with them in a capacity-building way. Should we have a separate mechanism for such proposals? Or could this particular proposal be broadened in a future revision?

Bob Duce completed the discussion of working group proposals by summarizing the ranking among the proposals: (1) zooplankton, (2) viruses, and (3) myctophid fish.

3.0 LARGE-SCALE SCIENTIFIC PROGRAMS

3.1 SCOR/IGBP Joint Global Ocean Flux Study (JGOFS)

The JGOFS Executive Committee met for the final time in September 2003 to finish its business. The JGOFS International Project Office (IPO) closed on 31 December 2003 and distributed the final version of its Web site on CDs. It is also still on-line at the University of Bergen. Project files were shipped to the Woods Hole Oceanographic Institution Library for archiving. The JGOFS Executive Committee decided to try to write an article on the history of JGOFS.

3.2 SCOR/IGBP/IOC Global Ocean Ecosystems Dynamics (GLOBEC) Project (see Annex 6)

GLOBEC held its 2004 SSC meeting in Swakopmund, Namibia, to make it possible to meet in conjunction with the annual meeting of BENEFIT, one of GLOBEC's regional contributing activities (from South Africa, Namibia, and Angola). The GLOBEC SSC continued planning its synthesis activities and planning for joint activities with IMBER, and reviewed draft science plans for two new regional activities, one in the sub-arctic seas and the other for high trophic-level fish in tropical regions. GLOBEC and IMBER have agreed to work together on studies related to end-to-end food webs.

Akira Taniguchi, the Executive Committee Reporter for GLOBEC, stated that he has attended some GLOBEC meetings, especially related to the Small Pelagics and Climate Change (SPACC) activity. Taniguchi is impressed by GLOBEC science and activities. 1500 people attended the 4th International Fisheries Congress in Vancouver, which included some GLOBEC-relevant sessions. However, the atmosphere of the congress was very pessimistic about the status of fisheries, except for the stocks of small pelagic species, which are being massively harvested. We need to communicate concerns to society and back it up with good scientific understanding, which we will get from GLOBEC.

Manuel Barange, the GLOBEC Executive Officer, made a presentation about recent research highlights from the project:

- Changes in North Sea plankton stocks precede decreases in cod stocks by one year; there is a steady and matched decline, especially in relation to the copepod *Calanus finmarchicus*. There has been a shift between *C. finmarchicus* and *C. helgolandicus*. This is significant because *C. helgolandicus* is less available as prey for fish larvae.
- In the North Atlantic Ocean, studies of the abundance of *C. finmarchicus* have led to development of a “*Calanus*-focused model”, whose testing is ongoing. We can now describe the dynamics of *C. finmarchicus* in the entire North Atlantic Ocean.
- Southern Ocean GLOBEC research focused on krill, its competitors, and its prey, for two full seasons. Satellite tags were placed on crabeater seals and penguins to measure their

movements, as well as temperature and salinity measurements. Such data provide a description of the fall-to-winter transition in the Southern Ocean coastal waters for the first time. SO GLOBEC has observed bottom intrusions of Circumpolar Deep Water in all seasons.

- In the Equatorial Pacific Ocean, the Oceanic Fisheries and Climate Change Project (OFCCP) has been putting together models to determine variability of the three main tuna species in that region.
- The SPACC activity is building circulation models for each SPACC upwelling area to permit comparative studies.
- GLOBEC is trying to link natural and social sciences, for example, in the SPACC workshop on the economics of small pelagic fishes and climate change, and through its Focus 4 group.

Barange continued by reviewing the regional programs. Climate Impacts on Oceanic Top Predators (CLIOTOP) and Ecosystem Studies of Sub-Arctic Seas (ESSAS) are the two new programs under development. At the same time, GLOBEC is beginning the process of synthesis and integration, with a sequence of symposia in 2004-2009 to contribute to the process. Funding for the IPO has been renewed from the UK through 2009.

Robert Duce thanked Manuel Barange for his presentation and opened discussion. Mike MacCracken noted that the Arctic Climate Impact Assessment is due in a few months. It will discuss impacts on fisheries of reduced sea ice cover. Barange replied that ESSAS is not getting into scenario analysis and prediction. This will require more substantial analysis and understanding that may come after ESSAS.

3.3 SCOR/IOC Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Program (see Annex 7)

Julie Hall, the Executive Committee Reporter for GEOHAB, reported that Grant Pitcher (GEOHAB chair) was at the Project Coordination Meeting in Mestre last week. GEOHAB's *Implementation Plan* was approved after the 2003 Executive Committee meeting. GEOHAB has embarked on a series of focused open science meetings to create research plans for its four Core Research Projects. Two have been held so far: (1) HABs in Upwelling Systems (in Lisbon, Portugal) and (2) HABs in Fjords and Coastal Embayments (in Viña del Mar, Chile). The plan from the Upwelling meeting will be published in early 2005 and presents 8 key science questions. The plan for the Fjords and Coastal Embayments meeting is in progress. The final two open science meetings will be held on HABs and Eutrophication (March 2005 in Baltimore, Maryland, USA) and HABs and Stratification (in Paris, France in December 2005). The OSM in HABs and Eutrophication planned for Baltimore in March should have more participants than the first two OSMs. Each OSM is producing a research plan, which can be adopted by national research communities, in part or fully. The Executive Committee approved the addition of six SSC members during the year and appointment of Marcel Babin (France) as the SSC's Vice-

Chair. New SSC members include Einar Dahl (Norway), Raphael Kudela (USA), Alicia Lavin (Spain), Dennis McGillicuddy (USA), and Ming-Jiang Zhou (China-Beijing). The next SSC meeting will be held in Cape Town, South Africa in conjunction with the biennial international HAB meeting in November 2004.

The major concern for GEOHAB now is that it still has no IPO. Henrik Enevoldsen (IOC) and Ed Urban provide part-time IPO support. But, GEOHAB really needs a formal IPO in order to move the project forward more quickly. Henrik Enevoldsen added that SCOR-IOC cooperation on GEOHAB has been good. Catherine Jeandel reported that The Oceanography Society (TOS) meeting in Paris in June 2005 has a special session on harmful algal blooms, being convened by two GEOHAB scientists.

3.4 SCOR/IGBP/WCRP/CACGP Surface Ocean-Lower Atmosphere Study (SOLAS)

(see Annex 8)

Laurent Labeyrie, the Executive Committee Reporter for SOLAS, stated that SOLAS is working so well that he has nothing to do. The SOLAS IPO has been established in the United Kingdom and SOLAS is seeking support for its focus activities. SOLAS will hold its first open science meeting as an official project in Halifax, Nova Scotia, Canada in October 2004. SCOR is contributing US\$15,000 of its NSF science funding for the conference, plus an additional \$7,500 for the participation of developing country scientists in the meeting, from a separate NSF grant. SOLAS and IMBER have agreed to create a cooperative research activity related to ocean carbon.

Casey Ryan (SOLAS IPO) made a presentation about SOLAS. He reported that SOLAS is an international, 10-year project which has the aim to achieve quantitative understanding of the key biogeochemical-physical interactions and feedbacks between the ocean and the atmosphere, and of how this coupled system affects and is affected by climate and environmental change. Since the previous SCOR annual meeting, the SOLAS *Science Plan and Implementation Strategy* was completed, the SOLAS Web site was established (www.solas-int.org), and three Implementation *Plans* currently are being drafted. National SOLAS research has begun, including in Canada (US\$7.5 million, 80 scientists) and the United Kingdom (US\$20 million over 5 years). The UK program includes funds for the International SOLAS IPO and plans for an atmospheric monitoring station on the Cape Verde Islands. New Zealand, Japan, China (Beijing), Brazil and France also have funded SOLAS programs. In Germany, Norway, Belgium, and the EU, SOLAS proposals are being prepared or have been submitted. SOLAS networks being built in the United States, India, South Korea, Russia, Chile and, China (Taipei). One of the goals of SOLAS is to generate new CO₂ flux data in areas and seasons where such data are now missing; for example, obtaining new data from the Southern Ocean in winter is critical for better constraining interannual fluxes of CO₂. Other specific scientific foci of SOLAS will be iron-enrichment experiments and high wind-speed measurements of gas exchange. In terms of capacity building, SOLAS is focusing its efforts on its Summer Schools (the second one will be

held in 2005), its triennial Open Science Conferences (one upcoming in October 2004), and travel grants. Peter Liss, the SOLAS Chair, complimented Ryan's presentation and stated that he had nothing to add.

3.5 SCOR/IGBP Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) Project (see Annex 9)

John Field, Executive Committee Reporter for IMBER, reported that the IMBER *Science Plan and Implementation Strategy* was reviewed by SCOR and IGBP and approved, in principle, by both co-sponsors, in 2004. SCOR and IGBP also approved the IMBER SSC membership in 2004. The SSC was appointed with half of its members from the previous IMBER Transition Team and half new members. The IMBER SSC first met on 9-12 August 2004 in Plymouth, UK to discuss how to revise the *Science Plan and Implementation Strategy* to respond to reviewers' comments and to begin planning implementation activities. Field attended part of the meeting.

Julie Hall, the IMBER chair, gave an overview of IMBER science plans and activities. Before the 2003 SCOR meeting, a draft IMBER plan was put on the Web for community comments. Comments were received from about 50 people. Hall presented IMBER's themes:

- Theme 1 – Interactions between biogeochemical cycles and marine food webs
- Theme 2 – Sensitivity to global change
- Theme 3 – Feedbacks to the Earth System
- Theme 4 – Responses of Society

Each theme contains several issues and each issue has a few key scientific questions. The issues and key scientific questions help focus the themes.

Hall reviewed upcoming activities. IMBER has been very fortunate to have had support for an interim IPO, primarily from IGBP, but also from SCOR, the New Zealand National Institute of Water & Atmospheric Research (NIWA), and the Plymouth Marine Laboratory (PML). IMBER now has an offer of funding for an IPO in Brest, France for three years. IMBER has several regional and national planning activities ongoing, for example, EUR-OCEANS in the European Union, Integrated analysis of Circumpolar Climate interactions and Ecosystem Dynamics (ICCED) in the Southern Ocean, and national activities in Germany, UK, China, and France. There has been a proposal for an IMBER summer school. IMBER is developing a mechanism for endorsement of projects. ICCED will hold a planning meeting in Cambridge, UK in May 2005.

Catherine Jeandel asked what links IMBER has to people working on the high CO₂ and low pH issue. Julie Hall replied that several SSC members attended the May 2004 SCOR/IOC symposium on The Ocean in a High-CO₂ World. IMBER has had good interactions with the CO₂ community and with SOLAS. Huasheng Hong asked about the interactions of IMBER with

GLOBEC and with social science issues. Hall answered that IMBER has worked closely with GLOBEC from the start. The two projects are working on a joint implementation activity and shared work on modeling. Regarding human dimensions, the next step is to get the natural and social science communities together. IMBER has not yet put a social scientist on the SSC; this has been difficult. IMBER plans to have a workshop on the social science issues and then form a small group to take the topic forward. Some discussion followed about this issue and the need to set research priorities within IMBER.

3.6 GEOTRACES Planning Committee

The GEOTRACES Planning Committee met for the first time in Oxford, UK in June 2004, to begin creating their science plan. Five national GEOTRACES communities (in France, Germany, Japan, the United Kingdom, and the United States) held scientific meetings to specify their particular interests in GEOTRACES, which will contribute to the international GEOTRACES science plan. New funding has been secured from NSF for GEOTRACES to continue its international planning through SCOR. These funds will be used for an editorial meeting and meetings of subcommittees for data management, and for standards and intercomparison experiments.

Robert Duce, the Executive Committee Reporter for GEOTRACES, reviewed the background of the formation of GEOTRACES and introduced Robert Anderson (USA), the Co-Chair of the Planning Committee. Anderson made a presentation about the project. An important aspect of GEOTRACES is that using multiple geochemical tracers helps understand ocean processes better than studying tracers individually. Bjørn Sundby asked whether inorganic chemical kinetics will be studied. Anderson responded that such studies (including laboratory studies) will be carried out mostly in terms of particle reactions. Peter Liss added that it will be difficult to study kinetics in GEOTRACES; they are more likely to be studied in related projects like SOLAS and IMBER. Ron O'Dor asked whether analyses are done at sea or in the lab. Anderson answered that more and more analyses are done at sea as technology develops. However, some measurements must still be done in the laboratory. For example, scientists using mass spectrometers have to bring samples back to the lab. Alan Sielen asked whether contaminated areas can be used to study behavior of the contaminants. Anderson responded that GEOTRACES will only study contaminants as tracers of ocean processes and as regional sources to study far-field effects. Huasheng Hong asked how GEOTRACES will choose types of trace elements to study. Anderson replied that GEOTRACES wants to study micronutrients, tracers of source materials, and radiotracers (to give information about the rates of ocean processes and other paleo-proxies). GEOTRACES does not have a definitive list of trace elements and isotopes that it will study yet, and he's not sure they should develop an exclusive list. John Field stated that GEOTRACES is rapidly developing into a nice-looking project. When the SSC must be appointed, it's going to be difficult to include developing countries since the field is one of high technology, ultra-clean techniques, and SCOR should take this into account. Anderson responded that there is a long tradition of radioisotope work in India.

GEOTRACES is trying to make contacts in Latin America. China still lacks some of the clean sampling techniques for open-ocean work, but Anderson hopes to get funding for a workshop in China to promote Chinese participation in cruises and process studies. Duce added that GEOTRACES will have a good opportunity for capacity building.

3.7 Land-Ocean Interactions in the Coastal Zone (LOICZ) Project

Julie Hall, Executive Committee Reporter for LOICZ, reminded participants that SCOR agreed in 2002 to sponsor Theme 4 of LOICZ and related LOICZ research on biogeochemical transformations in the coastal and shelf regions. Hall recommended that LOICZ should develop strong ties to IMBER, pending development of financial support for LOICZ. SCOR has not yet been able to secure funds to assist LOICZ directly, but has provided some support to LOICZ to support travel of developing country scientists to LOICZ-related meetings.

LOICZ is entering its Phase 2 and is generating a new Science Plan, which is in its final stages of development. LOICZ 1 had a focus on element budgets, which LOICZ II will update. LOICZ will also continue with development of its coastal typology. LOICZ has co-sponsored several SCOR working groups in the past and is currently co-sponsoring WG 122 on Mechanisms of Sediment Retention in Estuaries. LOICZ has requested travel funds for their open science meeting, which SCOR agreed to provide. The LOICZ IPO was entirely funded by The Netherlands for its first 10 years; this funding will expire in 2005 and LOICZ is actively seeking new funding. Paola Rizzoli queried about LOICZ problems in the United States. Ed Urban explained the history of LOICZ in the United States.

4.0 OCEAN CARBON AND OTHER ACTIVITIES

4.1 SCOR/IOC Advisory Panel on Ocean Carbon Dioxide

The terms of panel members expired at the end of 2003. Much discussion has taken place in the past year on how to reform the Panel, its new terms of reference, and how it would relate to (1) the International Ocean Carbon Coordination Project (IOCCP), which it co-sponsored and which has continued its activities; and (2) SOLAS and IMBER.

Robert Duce, Executive Committee Reporter for this panel, explained SCOR's reasons for not extending the group and the need to re-examine its terms of reference and members. A new structure and terms of reference were not presented because discussions are still ongoing with IOC and the scientific community.

Ed Urban summarized IOCCP activities since the previous SCOR annual meeting. IOCCP's major activity was a conference on "Ocean Surface pCO₂, Data Integration and Database Development" in Tsukuba, Japan in January 2004, convened in cooperation with PICES. Maria Hood continues to maintain an excellent IOCCP Web site at IOC. IOCCP has identified ocean carbon scientists to serve on the CLIVAR basin panels, to help oversee the implementation of

carbon measurements on CLIVAR cruises. IOCCP has also been working directly with regional projects to link them and is promoting discussions of the needs of the ocean carbon modeling community. IOCCP is facilitating the revision and expansion of the DOE CO₂ Methods Handbook. IOCCP has worked with the American Geophysical Union (AGU) to develop a policy for the proper citation of large-scale data sets in AGU publications and is promoting the compilation and public release of historical pCO₂ data sets.

SCOR is seeking to ensure that the many international carbon activities are well harmonized before SCOR requests new funds for IOCCP from NSF. Peter Liss commented that IOCCP is out of a mandate and out of money, but it has done a very good job, and we should try to find an interim mechanism to have them meet while the discussions are going on. Urban responded that IOCCP only has one permanent member; they have invited people depending on the topic to be discussed. Once the new international structures are set, it will not take long to implement them.

4.2 SCOR-IOC International Symposium on “The Ocean in a High-CO₂ World”

Robert Duce, Executive Committee Reporter for this activity, reviewed the symposium, the report in the meeting book, and the completed and forthcoming publications. James Orr (France) was appointed as Vice-Chair of the Planning Committee in 2004, to assist the chair, Ralph Cicerone. The symposium was held at UNESCO in Paris, France in May 2004. The symposium addressed the biological and biogeochemical consequences of increasing atmospheric and oceanic CO₂ levels, and possible strategies for mitigating atmospheric increases. Topics ranged from ocean physics, to chemistry and biology, including the impacts of elevated CO₂ 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 CO₂ 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.

The symposium was mentioned in an article in the *New York Times* weekly science section, as well as in other printed and on-line newspapers. The UNESCO press release generated much interest. Papers from the symposium will be published in a special section of the *Journal of Geophysical Research—Oceans*. In addition, a summary of research priorities from the discussion sessions was prepared and will be distributed to research agencies worldwide. A meeting summary was published in *EOS*. The new Panel that will replace the SCOR/IOC Advisory Panel on Ocean CO₂ will be responsible for continuing follow-up activities related to ocean carbon sequestration science and ocean acidification. SOLAS and IMBER will follow up on the research recommendations made by symposium participants.

Ed Urban added that a UK Royal Society study on ocean acidification is under way. Papers for *JGR—Oceans* special section are in review. IOC has suggested that SCOR and IOC convene similar meetings on a regular basis; Urban added that if this symposium is repeated, it should be linked to the IPCC cycle so as to have a positive impact on that process.

4.3 Other Activities

4.3.1 Basin-Scale Modeling

SCOR and IOC co-sponsored an activity in 2003 to bring together experts to examine how existing models can be scaled up to basin scales, requested by IOC. The activity resulted in an article in *Science*.⁶ Scientists from GLOBEC, JGOFS, IMBER, and PICES were involved.

Ed Urban referred to the *Science* article and the background to IOC funding (since WG 119 didn't meet, IOC asked SCOR to use its annual funding from IOC for this activity). GLOBEC had identified the need for the topic to be discussed through its Focus 3 Working Group on Prediction and Modeling. The group met twice. Manuel Barange added that this activity was successful because the group was given a clear remit, had two quick meetings, and was able to produce a good *Science* paper in a short time frame. The approach to basin-scale models is very important to GLOBEC. Urban added that he hopes that GLOBEC and IMBER will work together on developing models that include both ecosystems and biogeochemical cycles.

4.3.2 The Global Iron Cycle

Robert Duce reported that SCOR was a supporting applicant for a proposal from IGBP to ICSU for an IGBP “fast-track initiative” activity on the global iron cycle, which brought together experts on oceanic, atmospheric, and terrestrial aspects of the global iron cycle to document our current state of knowledge about the iron cycle. Peter Liss added that the group met just once and has produced a worthy review of the iron cycle that is about to be submitted to *Science*.⁷ Three other papers on more specialized aspects of the global iron cycle will be submitted to *Global Biogeochemical Cycles*. Duce thought this fast-track approach worked well.

4.3.3 Data Management

SCOR obtained funding from NSF to convene a meeting (with help from IGBP) to bring together project scientists and data managers to recommend to projects the key elements of their data policies. The meeting was chaired by Roy Lowry of the British Oceanographic Data Centre. SCOR and IGBP convened this meeting because of the need of SOLAS, IMBER, and GEOHAB for such a policy. The policy was distributed to all the projects that participated in the meeting. All of the above projects, plus GEOTRACES, have considered the recommendations at their meetings, as well as to projects that attended the Project Coordination Meeting described in Section 4.3.4. JGOFS and WOCE representatives provided experience and advice to the newer projects. The meeting report provides a template for project data management. Future meetings were recommended and SCOR will try to find funds to make this possible. Ensuring that data management systems are inter-operable also requires another meeting and funding for it. SCOR

⁶deYoung, B., M. Heath, F. Werner, F. Chai, B. Megrey, and P. Monfray. 2004. Challenges of modeling ocean basin ecosystems. *Science* 304:1463-1466.

⁷Jickells, T.D. et al. 2005. Global iron connections between desert dust, ocean biogeochemistry, and climate. *Science* 308:67-71.

should also follow the issue of peer review and publication of data sets. Casey Ryan added that the meeting was very useful for emerging projects like SOLAS. The main challenge is to get resources in IPOs to do data management.

Wendy Broadgate added that IGBP appreciated this effort. She pointed out the finding in the report that data management requires about 10% of a program's budget and one-half person in an IPO. Ed Harrison (GOOS) commented that he does not like the recommendation that metadata management be decoupled from data management. Ed Urban responded that this was meant to recommend that IPOs are not necessarily responsible for keeping all the data in-house, as JGOFS did, just the metadata. Harrison added that 10% of the project budget should allow full data management.

4.3.4 Project Coordination Meeting

SCOR obtained funding from the Alfred P. Sloan Foundation to convene a meeting of representatives of the major large-scale ocean research projects, both SCOR-sponsored and others. The meeting was held near Venice during the week before the 2004 General Meeting and was co-chaired by John Field and Laurent Labeyrie. The purpose of the meeting was to bring together representatives of the major international ocean research and observation projects and programs to discuss common opportunities, issues and, problems. The topics for discussion were an update on results from the data management meeting described in Section 4.3.3, project-GOOS cooperation, project collaboration on Southern Ocean research, project needs for time-series stations, project input to global assessments, and other topics of interest to the participants.

John Field reported that the meeting included representatives of virtually all international marine research projects. Robert Duce noted that apparently the meeting was very successful and wondered why SCOR hadn't sponsored such a meeting previously.

Catherine Jeandel asked whether cruise schedule coordination was discussed. It would be useful to have one place where information on cruise plans would be available. This is done in France, but we need an international database. Field responded that this topic was discussed. It is not explicit in the meeting recommendations, but it should be. There should be a list of planned cruises in a database somewhere, along with information on past cruises. Carlo Heip noted that several European efforts are already underway, such as through EUR-OCEANS. iAnZone has some empty berths for Southern Ocean cruises and offered them to other projects at the meeting. The University of Delaware has a cruise database that might be useful. Peter Liss responded that, in the end, it is the scientists in countries sponsoring cruises that have to change their systems in the ways needed by the international community to make cruise information available.

Hein de Baar noted that there is an increasing mis-match between international projects and national funding agencies. SCOR and IGBP should consider this and find a way to deal with it.

Ed Urban responded that one action could be for national SCOR and IGBP committees to include project scientists from their countries as members of their national committees.

4.3.5 Panel on New Technologies for Observing Marine Life

Annelies Pierrot-Bults reported that the 2003 Executive Committee meeting approved the transformation of WG 118 on New Technologies for Observing Marine Life to a panel of the same name. Elgar de Sa (India) was approved as the Panel chair and terms of reference were approved for the Panel. The Sloan Foundation approved a three-year grant in 2004 for the Panel's activities. The panel membership is now under development. The first meeting of the panel will be held in Goa, India in February 2005.

Ron O'Dor noted that he has seen plans for a new Web site that includes a meeting space for the panel only to exchange ideas and a public area. Ed Urban confirmed this information and added that the panel Web site is being designed to be a dynamic system that is updated with new information and articles on a regular basis. This panel will work more closely with CoML projects than did WG 118. It will seek guidance from the panels as to their technology achievements and needs.

5.0 CAPACITY-BUILDING ACTIVITIES

5.1 Regional Graduate Schools of Oceanography and Marine Environmental Sciences

The Executive Committee formed a small committee at the 2002 General Meeting to determine how to proceed with this activity, co-chaired by John Field and Ilana Wainer, and also including Huasheng Hong and Manuwadi Hungspreugs (Thailand). SCOR submitted a proposal to ICSU, supported by the Third World Academy of Sciences and the International Union of Geodesy and Geophysics (IUGG), to further develop the idea in the target regions. The proposal was not funded by ICSU, so other, regional funding sources will be approached.

Ilana Wainer made a plea for more communication between nations and existing schools. This is a problem in South America, at least. John Field reported that things are starting to come together on this topic; there has been activity in three regions. For Southeast Asia, John Field has contacted Helen Yap in the Philippines and she is keen to cooperate. For southern Africa, they are well aware of sensitivities of countries and institutions regarding recognition of a center of excellence in the region. They are trying to set up a partnership and this has been approved under the auspices of the BENEFIT program and the Benguela Current Large Marine Ecosystem (BCLME) program. In Southern Africa, students will be invited from South Africa, Namibia and Angola to come to different centers for short courses, or professors will travel to give courses. They hope to start these activities in 2005, which might later be expanded to include other African countries. Huasheng Hong added that Xiamen University has a summer school in marine science that could be expanded to include graduate studies and training courses and to

accept foreign students, not only Chinese students. They have a UN Development Programme international meeting coming up and will discuss this effort there.

Ilana Wainer added that the Brazilians are also trying to develop a partnership in their region. There are many activities going on for capacity building in South America, but they are not coordinated. Wainer hopes that SCOR can help with this. Ed Urban added that a major problem is competition among countries within each region. One possibility for the next steps is to encourage regional meetings where countries and institutions figure out how to share resources and provide equal opportunities for different nations to host activities, rather than to compete with one another. Perhaps the Asia-Pacific Network for Global Change Research (APN) could fund such a meeting in southeast Asia. Field added that two types of funding are needed: (1) scholarships for students and (2) funding for visiting professors. Wendy Broadgate suggested that SCOR contact START regional offices. They have existing networks that we might build on.

ICSU is starting a system of regional centers. Geoff Brundrit (South Africa) will represent SCOR at the first meeting of African regional center. Working with START, ICSU, and the Inter-American Institute for Global Change Research (IAI) in their regions is a good approach and we can take advantage of their networks. Colin Summerhayes commented that SCOR could work with other organizations with similar interests, such as IOC.

5.2 POGO-IOC-SCOR Visiting Fellowships for Oceanographic Observations

Ed Urban summarized information about this program. Four sets of fellowships have been awarded (13 each in 2001 and 2002, 8 in 2003, and 12 in 2004). Fellows, host institutions, and sending institutions are generally enthusiastic about the program. Urban noted that he tries to ensure that the fellows funded by SCOR are focused on observations. (Many of the applicants propose research projects or to learn research methods.) Peter Burkill added that he is hosting a fellow this year, who is learning quickly. Burkill is concerned about what happens when the fellow returns to India; he feels that it is the responsibility of the parent institution to make the best use of the expertise gained. Laurent Labeyrie thinks that too few countries seem to know about the program. Urban responded that information about the fellowships is transmitted through both SCOR and POGO members. Venetia Stuart added that IOCCG also offers a fellowship along the same lines, specifically for students in ocean color research. The fellows hosted at the Bedford Institute of Oceanography have all had much communication and links with their hosts for several years.

5.3 NSF Travel Support for Developing Country Scientists

SCOR is in the third year of a three-year grant from NSF for these awards (the present grant expires in June 2005), at a level of \$75,000 per year. The grants have been an important source of support for several SCOR-related meetings in the past year, including

- GLOBEC SPACC Meetings (egg production and economics) and Zooplankton Symposium,
- WG 119 Symposium on Quantitative Ecosystem Indicators for Fisheries Management,
- POGO-IOC-SCOR Fellowships
- SOLAS, GEOHAB, and CLIVAR Open Science Meetings
- the Symposium on The Ocean in a High-CO₂ World
- SCOR-relevant workshops at the PICES annual meeting
- the History of Oceanography meeting, and
- the IGBP/SCOR workshop on the global iron cycle.

181 individuals have received support in the past two years. The SCOR Executive Committee approved meetings to receive funding for the remainder of the existing grant, plus some meetings that would only receive support if the grant is renewed. Colin Devey (InterRidge) and Manuel Barange (GLOBEC) reiterated the usefulness of these funds.

5.4 SCOR Reports to Developing Country Libraries

The SCOR Secretariat distributed three reports to developing country libraries since the 2003 SCOR meeting. 42 libraries in 30 nations receive copies of SCOR publications. It typically costs SCOR about US\$2,000 per report to purchase the copies and additional costs to send them.

5.5 Third World Academy of Sciences

TWAS considers itself the academy of sciences for the developing world. Its principal aim is to “promote scientific capacity and excellence for sustainable development in the South.”⁸ TWAS operates under UNESCO, but is supported by the Italian government and other sources. TWAS is located in Trieste, Italy at the Abdus Salam International Center for Theoretical Physics. SCOR has interacted with TWAS intermittently in the past, including meeting together at the SCOR Executive Committee Meeting in Rio de Janeiro, Brazil, in 1997. Daniel Schaffer (TWAS) made a presentation about TWAS activities. He stated that TWAS has been in the business of capacity building for 20 years. They have a lot of experience and a wide network. TWAS membership includes about 700 scientists; 80% are from the Southern Hemisphere and 20% who are Associate Members from the Northern Hemisphere. Sixteen are Nobel Laureates. The objectives of TWAS are to

- Recognize, support and promote excellence in scientific research in the South
- Respond to the needs of scientists working under unfavorable conditions
- Support South-South scientific exchange and collaboration

⁸ See <http://www.twas.org/>

- Promote South-North cooperation between individuals and centers of excellence
- Promote dissemination of scientific information and sharing of innovative experiences

The major activities of TWAS relate to promoting scientific excellence and responding to research needs of developing countries. Research grants are their largest single program. TWAS supports exchanges, for example, post-doctoral and post-graduate fellowships (about 50 per year) and visiting associateships for senior scientists. TWAS also supports meetings in developing countries, about 30 meetings per year.

The Third World Network of Scientific Organizations (TWNSO) is an inter-institutional network that builds political support and creates networks in developing countries linked to UN millennium goals like safe drinking water, biodiversity, etc. It is the institutional arm of TWAS. TWNSO helps to

- Build joint political support for science-based economic development
- Develop and share innovative experiences in the application of science and technology to sustainable development
- Develop thematic networks of centres of excellence to address specific development-oriented problems

TWNSO addresses specific problems, such as (1) conservation, management and sustainable use of water resources in the South; (2) application of innovative renewable energy technologies in the South; (3) sustainable utilization of biodiversity in arid and semi-arid lands; and (4) sustainable use of medicinal and indigenous food plants in developing countries.

The Third World Organization for Women in Science (TWOWS) was established in 1993 with the help of TWAS. TWOWS today unites nearly 2400 women scientists and more than 80 institutions in 87 developing nations and 27 countries in the North. It includes a “sandwich program” to help young women scientists attend a center of excellence in another developing country, although they still get their degree from their home university. With funds from the Department for Research Cooperation of the Swedish International Development Cooperation Agency, TWOWS offers fellowships for postgraduate training to young women scientists from sub-Saharan African and Least Developed Countries at centers of excellence in the South. More than 200 fellowships have been offered to students in 37 countries in the three years since the program began.

The Inter-Academy Panel (IAP) arose from the U.S. National Academy of Sciences and the UK Royal Society to build the capacity of science academies in the North and South. The IAP has created regional academies and networks of academies. In particular, IAP strives to (1) assist academies in developing countries to build their capacities; (2) serve as a forum for discussions on the complex relationship between science, society, and media; (3) sustain efforts to reform science education; and (4) issue statements on topics of global concern

Robert Duce asked whether TWAS and SCOR could cooperate in development of regional working group proposals from developing countries. Schaeffer responded that TWAS has a series of new regional offices (in India, China, Brazil, and Kenya) that are very eager to cooperate with other organizations, so this might be a vehicle. Duce stated that SCOR should explore this possibility. Alan Sielen asked how TWAS establishes priorities with so many different countries involved. Schaeffer responded that the countries have to decide their own priorities; TWAS' role is to help them.

5.6 ICSU Priority Area Assessment (PAA) on Capacity Building

SCOR nominated four individuals to the ICSU PAA committee, but none were selected. Robert Duce reminded meeting participants that the ICSU review of SCOR complimented SCOR on its capacity-building activities.

6.0 RELATIONS WITH INTERGOVERNMENTAL ORGANIZATIONS

6.1 Intergovernmental Oceanographic Commission

Robert Duce and Ed Urban attended the IOC Executive Council in June 2004 to represent SCOR and made interventions related to GESAMP, the proposed SCAR-SCOR-IOC Southern Ocean research coordination activity, and follow-up for the WG 119 symposium.

6.1.1 Coastal Ocean Advanced Science and Technology Studies (COASTS) Meeting

The COASTS meeting was held in 2001 and two volumes of *The Sea* are being prepared. Ed Urban reported that the books (two volumes of *The Sea*) may be published this year, but he has no information on costs of the volumes.

6.1.2 Global Ocean Observing System (GOOS)

SCOR has input to GOOS through ICSU. John Field is the new chair of the GOOS Steering Committee. Tom Malone (GOOS/Coastal Ocean Observations Panel [COOP]) and Ed Harrison (GOOS/Ocean Observations Panel for Climate [OOPC]) made presentations about GOOS.

Malone presented the development of the coastal component of GOOS. Their goal is to achieve "guaranteed, sustained, and routine provision of data." A coastal observing system needs to be capable of rapid and repeated detection of changes over a broad spectrum of time-space scales and timely predictions of such changes. It is desirable to tune the flow of environmental data and information to the time scales on which decisions should be made. We do not have this capability today, because of

- Inefficient, ineffective data management
 - Data are lost or not accessible
 - The time required to acquire, process, and analyze data of known quality is too long
- Under-sampling in time and space, and ecological complexity
 - Inputs to coastal ecosystems are poorly quantified
 - Long-term, high-resolution time series are lacking
 - Synoptic measurements of physical, chemical, and biological properties and processes are lacking
- Lack of capacity for rapid data acquisition and analysis of non-physical variables, such as remote and autonomous *in situ* sensing and real-time telemetry and operational models for assimilating and analyzing data with speed and skill.

The goals of the Coastal Module of GOOS are to provide data and information required for more rapid detection and timely prediction of the effects of extreme weather, climate change and human activities, particularly in relation to

- Safety and efficiency of marine operations (e.g., surface currents, waves, sea level, temperature, salinity, coastal flooding, and erosion)
- Public health and safety (e.g., seafood contamination and ambient levels of pathogens)
- Condition of marine and estuarine ecosystems (e.g., loss of habitat, biodiversity, coastal eutrophication, anoxia, harmful algal blooms, invasive species, mass mortalities, chemical contamination, declines in living resources, aquaculture production)
- Living marine resources (see previous bullet point)

Operationally, Coastal GOOS would consist of Regional Coastal Ocean Observing Systems (RCOOSs) that would contribute to a Global Coastal Network (GCN). The GCN would contribute to the RCOOSs by identifying a small suite of variables required by most RCOOSs, setting up reference and sentinel stations, promoting the development of standards and protocols, and helping to scale up from the coastal to basin scale. The GCN will be built through GOOS Regional Alliances (GRAs) and GOOS national programs, with assistance from LME programs, regional seas conventions, and regional fishery bodies. The World Weather Watch is an appropriate model for an operational, user-driven, end-to-end observing system. Malone described the synergy between research and the development of operational capabilities, as discussed at the Project Coordination Meeting during the previous week. In this relationship, GOOS provides guaranteed, sustained data streams specified by the science community, capacity building, and demand for new technologies and models. The research projects provide new technologies and models, capacity building, and demand for operational data and products. SCOR activities that are most relevant to Coastal GOOS are

- WG 111 on Coupling Wind, Waves and Currents in Coastal Models
- WG 115 on Standards for the Survey and Analysis of Plankton

- WG 119 on Quantitative Ecosystem Indicators for Fisheries Management
- GLOBEC
- GEOHAB
- IMBER
- Basin-scale modeling
- Project data management policies
- Panel on New Technologies for Observing Marine Life

Hein de Baar commented that we can do a lot in physical oceanography, meteorology and other measurements through GOOS, but we need an emphasis on the development of reliable sensors for biology and chemistry. Malone responded that some progress is being made, for example on genetic probes. Peter Liss asked how we can develop synergy between GOOS and the research community and technologists. Malone responded that we need to establish some formal mechanisms. Harrison added that all information collected under auspices of GOOS is supposed to be available freely to users. Mingyuan Zhu asked whether it is the same community that does research and observations. Malone answered that we need to establish a separate operational observation community; if scientists continue to do it too long, they get diverted from research. Colin Summerhayes suggests there should be someone from SCOR more directly involved in GOOS meetings, rather than only someone from the ICSU Secretariat. Peter Liss agreed that representation on GOOS and GOOS-like groups should be at a much more active (rather than institutional) level.

Ed Harrison, the OOPC chair, made a presentation about the development of OOPC. Despite near-heroic efforts, given the funding available, we have not managed to observe the global ocean well enough to meet most scientific or societal goals, such as observing ocean variables related to climate variability and change. OOPC is being designed to meet the existing and future open-ocean observational needs. The terms of reference for OOPC are

- Develop recommendations for a sustained global ocean observing system, in support of WCRP, GOOS and GCOS climate objectives, including phased implementation.
- Help develop a process for ongoing evaluation and evolution of system recommendations.
- Support global ocean observing activities by involved parties, via science advice and agreed observing plans

COOP's goals are to (1) deliver data and products to serve climate and ocean forecasting, climate assessment, and climate research; (2) deliver data in real time, as possible; and (3) make data and products easily available. The system is now about 50% completed and it is intended to complete the OOPC part of GOOS by 2010. It will include surface drifting buoys, tropical moored buoys, ships of opportunity, Argo floats, reference stations, coastal moorings, and an ocean carbon network. Observations alone will not provide the information for policy makers, environmental managers, climate scientists, and others. Also needed are routine products and useful indices of

the system, globally and regionally. This will require a new way of acquiring and using ocean data, including the need for long-term support for the system elements.

The Global Ocean Data Assimilation Experiment (GODAE) is an OOPC activity. GODAE's goal is to demonstrate the utility of ocean data assimilation-based products for society and science. It has three major components: (1) "real-time" ocean products and forecasts, (2) seasonal-interannual forecasts, and (3) climate analysis and reanalysis. GODAE Data Servers are working and improving. Its Comparison Projects are underway, with the North Atlantic Ocean most advanced. GODAE High Resolution Sea Surface Temperature Pilot Project products are to become available in 2004. A GODAE Summer School was held in September 2004 and the Second GODAE Symposium is scheduled for November 2004.

Catherine Jeandel stated that governments are more ready to listen to and fund people in operational oceanography and to provide less support to research. We need to support both communities. Harrison responded that each nation has its own attitudes and priorities, and that scientists in each country are best able to judge how to work with their systems. We need to forge partnerships among nations. Bob Anderson asked about the issue of maintenance of existing satellites versus deploying new ones. Which ones are most valuable? Harrison responded that we must emphasize the importance of continuity of observations when satellite agencies consider new missions. Mingyuan Zhu asked how we can couple observations of physical and biological properties. Harrison responded that we need to encourage people making these measurements to work together. OOPC is trying to equip commercial ships to do more underway sampling of properties like pCO₂ and chlorophyll a. OOPC would like input from scientists as to measurement needs. Colin Summerhayes stated that many of the observational systems in use are actually being run by the research community, but they are providing data that are useful to the operational community. Ed Harrison responded that, except for sea level observations, almost all other OOPC-related observations are being done by the research community. A crucial question is how to convince governments to invest in observation systems.

Julie Hall presented information about the Integrated Global Observing Strategy (IGOS) Coastal Theme. They have had three meetings in the past 18 months. The final plan will be presented to the IGOS Partners in October. This theme is serving as the interface between coastal GOOS and the coastal Global Terrestrial Observing System (GTOS), and is focused on both satellite and in situ observations. The review of IGOS Oceans Theme has not actually started. Hall urged SCOR to approach IGOS for a role in the revisions. John Field asked whether this should be done through ICSU. Hall suggested working through the IGOS Partners or Eric Lindstrom (NASA). Colin Summerhayes added that Keith Alverson (IOC) is now a co-chair of the IGOS Oceans Theme and is looking for a writing team in the next two months.

6.2 Other Intergovernmental Organizations

6.2.1 Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP)

Robert Duce is the Vice-Chair of GESAMP. He reported that SCOR participated in the GESAMP review a few years ago and the recommendations led to GESAMP developing a new strategic plan and a new Memorandum of Understanding among the supporting agencies, which is now being considered. GESAMP is in a transitional phase. Some of the new foci of GESAMP are closely related to the proposed Global Marine Assessment program. Resolution of the problems this causes may take a couple of years. A new report is due from GESAMP on oil in the marine environment.

6.2.2 North Pacific Marine Science Organization (PICES)

SCOR and PICES have cooperated in several activities in the past year. Alex Bychkov reported about PICES and SCOR common interests, particularly in relation to GLOBEC, JGOFS, SOLAS, IMBER, GEOHAB, IOCCP, and Working Group 119 on Quantitative Ecosystem Indicators for Fisheries Management. Bychkov thinks the area of marine zooplankton research (such as the proposed new working group) is a very strong area for interactions. Other joint interests relate to ecosystem indicators. PICES is preparing a report on the status of the North Pacific ecosystem and CO₂-related research. David Mackas added that PICES is planning a micronekton intercalibration experiment, which might have possible links to the proposed SCOR working group on Arabian Sea myctophid fish. Ed Urban thanked Bychkov and PICES for their interest and participation in SCOR activities.

7.0 RELATIONS WITH NON-GOVERNMENTAL ORGANIZATIONS

7.1 International Council for Science

SCOR was the lead applicant on one proposal to ICSU for 2005, for the Regional Graduate Schools of Oceanography project. The Third World Academy of Sciences and IUGG were supporting sponsors. SCOR served as a supporting sponsor on two other proposals, one for Physics and Chemistry as the Key to Marine Ecosystem Dynamics and Structure (PACKMEDS) project (led by SCOPE, with IAPSO) and the other for an activity to bring the marine natural science and social sciences communities together to discuss joint research possibilities (led by IGBP, with IHDP). None of the proposals received funds from ICSU, because ICSU funds for its grant program were significantly reduced.

ICSU published its Priority Area Assessment (PAA) on the Environment in Relation to Sustainable Development in February 2003, which was very favorable to SCOR.

Michael McCracken is a member of the Advisory Committee for the ICSU Workshop on Comet/Asteroid Impacts and Human Society. The workshop will be held in November 2004 in

Santa Cruz de Tenerife, Canary Islands. MacCracken reported on the status of planning for the workshop.

7.1.1 International Geosphere-Biosphere Program (IGBP)

Ed Urban attended the IGBP Science Committee meeting in Moscow, Russia in February 2003 to represent SCOR. Julie Hall also attended at IGBP's expense as the IMBER Transition Team chair. SCOR and IGBP staff members have regular discussions in relation to co-sponsored projects. IGBP and SCOR have worked since early 2003 on an "Ocean Vision" for the ocean projects that are part of IGBP. Guy Brasseur, the IGBP Chair, made a presentation about IGBP's current activities, the development of IGBP II (almost completed), and the Earth System Science Partnership's projects related to the carbon cycle, food provision, water resources, and human health. A several-year transition period has been required to synthesize IGBP I results and develop IGBP II, with new scientific questions and a new structure.

Catherine Jeandel expressed her concern about interactions among programs. Hein de Baar asked what IGBP is doing to influence governments. Brasseur responded that IGBP is strongly involved with the Intergovernmental Group of Funding Agencies (IGFA). Recently, IGBP had a good meeting in the United States with all agencies involved in global change research and has an opportunity to revitalize the U.S. national global change committee. In Europe, IGBP had a similar meeting that resulted in a workshop about four months ago between European Union (EU) activities and the Earth System Science Partners (IGBP, WCRP, IHDP, and Diversitas). They signed a joint statement agreeing to have international programs help in EU science planning processes and to begin discussions related to the 7th Framework Program. Huasheng Hong asked how to integrate national activities with international programs, and social sciences with natural sciences. Brasseur cited an unsuccessful example from Brazil, in which the economists that studied poverty, class structure, and other economic issues didn't believe that the environment is important. Michael MacCracken asked how programs like IGBP link to the Global Earth Observation System of Systems (GEOSS) and other observing systems. Brasseur responded that this is an important evolution. IGBP is involved in GEOSS; it needs science to underpin monitoring and prediction. IGBP has appointed Berrien Moore as its liaison on the issue.

Julie Hall stated that the IGBP regional projects have not included the marine system; are there plans to do this? Brasseur responded that there haven't been any proposals from the marine science community to be included. Laurent Labeyrie asked what IGBP is doing for IPY. Wendy Broadgate responded that most IGBP interactions with IPY will be at the project level.

Robert Duce summarized the discussions by stating that there have been and currently are many positive interactions between IGBP and SCOR. Duce asked what additional actions SCOR could take to strengthen its interactions with IGBP. Brasseur suggested that IGBP and SCOR representatives should meet more often and focus on specific actions and joint initiatives, rather

than merely co-sponsoring each other's programs. Brasseur added that IGBP has a new Executive Director, Kevin Noone, who is an atmospheric scientist.

7.1.2 World Climate Research Programme (WCRP)

WCRP is co-sponsoring the SOLAS project and SCOR projects are working well with CLIVAR, the part of WCRP most relevant to SCOR. Ed Urban attended parts of the WCRP meeting in Moscow in February 2004. SCOR provided funds for the CLIVAR Open Science Meeting in Baltimore for travel of developing country scientists and is providing funds to the CLIVAR IPO to help revise the WOCE hydrographic manual in terms of ocean carbon measurements.

The background book contains extensive information on the WCRP Coordinated Observation and Prediction of the Earth System (COPEs) activity, which is a new focus for WCRP. SCOR needs to be sure it understands COPEs, so that SCOR can interact effectively with WCRP. Michael MacCracken reported that COPEs is a framework for coordination within WCRP. Traditionally, the WCRP Joint Scientific Committee (JSC) has been an evaluator; now it will be an integrator. This new strategy may be a response to the need to coordinate with IGBP and IHDP. Ed Urban asked whether SCOR should make any "official" input on COPEs. Ilana Wainer suggested waiting a little while to see what results from community discussions.

7.1.3 Scientific Committee on Antarctic Research (SCAR)

SCAR has proposed that SCAR and SCOR work together in Southern Ocean research coordination and the two organizations are discussing a variety of other cooperative activities. For example, they will co-sponsor a special session at the IAG/IAPSO/IABO meeting in Cairns, Australia, on the topic of integrated biological and physical oceanography in the Southern Ocean.

Colin Summerhayes, the new SCAR Executive Director, made a presentation about developments in SCAR. SCAR's objectives are to

- initiate, develop, and co-ordinate leading edge international scientific activity in the Antarctic region, and on the role of the Antarctic region in the Earth System;
- provide objective and independent scientific advice to the Antarctic Treaty Consultative Meetings and other organizations on issues of science and conservation affecting the management of Antarctica and the Southern Ocean;
- facilitate free and unrestricted access to Antarctic scientific data and information;
- develop scientific capacity in all SCAR Members, especially with respect to younger scientists, and to promote the incorporation of Antarctic science in education at all levels; and
- communicate scientific information about the results of SCAR's activities to the public.

SCAR is in a state of transition. It would like to work with SCOR in a variety of areas, including with iAnZone (which is now an affiliated project of both SCOR and SCAR), and the special

session at the IAG/IAPSO/IABO meeting in Cairns. SCAR is forming an Expert Group on Oceanography and would like to make it joint with SCOR, making sure not to duplicate other ongoing activities. The focus will be on interdisciplinarity. Its membership will have a physical oceanography focus at its beginning, but this will change to become more interdisciplinary over time. Julie Hall asked how the interaction will work. If SCOR will be an active participant, it needs to have input to terms of reference and membership. Major SCAR programs of relevance to SCOR include Antarctica and the Global Climate System, Antarctic Climate Evolution, and Evolution and Biodiversity in the Antarctic.

In relation to the International Polar Year (IPY), SCAR has an internal advisory committee on how SCAR should be involved. IPY has 6 major themes:

1. Determine present environmental status of polar regions by quantifying spatial and temporal variability;
2. Quantify and understand past and present environmental and human change in polar regions, to improve predictions;
3. Advance understanding of polar-global teleconnections on all scales, and of processes controlling these interactions;
4. Investigate unknowns at the frontiers of science in polar regions;
5. Use unique vantage point of polar regions to develop and enhance observatories studying Earth's core, Earth's magnetic field, geospace, the Sun, and beyond; and
6. Investigate cultural, historical, and social processes.

ICSU will approve this program by January 2005. SCAR would like to see the IPY plan strengthened in relation to data management and information strategy. SCAR wants better maps and observatories to result from IPY, as well as a Southern Ocean observing system.

Laurent Labeyrie stated that he is very impressed with the renewal of SCAR, and hopes that there will be synergy between SCOR and SCAR. If the Expert Group on Oceanography is truly a joint group, we can ensure synergy by setting agendas for the activity together. Labeyrie also asked whether SCOR should propose some of our programs (e.g., GEOTRACES) to be included in plans for IPY. Julie Hall stated that IMBER plans for ICCED to be submitted as part of IPY. GLOBEC is proposing a comparative study of sub-polar zones based on SO-GLOBEC and ESSAS projects. Bob Anderson reported that GEOTRACES has submitted Arctic and Antarctic plans to IPY and many countries have agreed to participate, in cooperation with other projects.

7.1.4 Scientific Committee on Problems of the Environment (SCOPE)

Annelies Pierrot-Bults, SCOR's liaison to SCOPE, reported that the next SCOPE General Meeting will be held in February in India; there is not much to report at this time. Pierrot-Bults reviewed the objectives of SCOPE, their "clusters" and rapid assessment projects. SCOPE primarily does state-of-the-art reviews and produces recommendations for future research. SCOPE's main emphasis has been terrestrial. The most recent joint work between SCOR and

SCOPE was the Oceans 2020 activity (with IOC also). SCOR was a supporting applicant to an unsuccessful SCOPE proposal to ICSU for an activity called Physics and Chemistry as the Key to Marine Ecosystem Dynamics and Structure (PACKMEDS). IAPSO was also a supporting applicant. PACKMEDS would be a rapid assessment project to look at the dynamics of semi-enclosed marine ecosystems, especially the integrated effects of changes in sediment and nutrient inputs from land, in the context of ocean physics and biogeochemistry. There will be a meeting in Bremen next week to explore this idea; Ed Urban will be attending for SCOR. Julie Hall added that PACKMEDS should involve existing programs like IMBER. Rizzoli agreed.

7.2 Affiliated Organizations

7.2.1 International Association for Biological Oceanography (IABO)

SCOR will meet in 2005 in conjunction with the IAG/IAPSO/IABO assembly in Cairns, Australia. Annelies Pierrot-Bults, IABO Chair, reported that IABO now has two Southern Hemisphere representatives on their board and the IABO Secretariat has moved to New Zealand. IABO has a new Web site, www.iabo.org, which will be hosted by the Scottish Association for Marine Science's Dunstaffnage Marine Laboratory. Most of IABO's recent effort has been devoted to planning the Cairns meeting. IABO has three special sessions there, on CoML, Pelagic Biogeography, and one with SCAR, SCOR, and IAPSO. IABO is sponsoring a meeting on data management with OBIS in Hamburg in November.

7.2.2 International Association for Meteorology and Atmospheric Sciences (IAMAS)

Michael MacCracken, IAMAS President, reported on the various groups planning "years" of different type in the near future, in addition to the IPY: International Year of Planet Earth (an outreach effort), Electronic Geophysical Year (involving sharing of data among disciplines), etc. MacCracken also reported on the recent IUGG Executive meeting. IUGG is beginning an initiative in southern Africa. The next IUGG General Assembly will be in Perugia, Italy in 2007. IUGG is concerned about whether GEOSS is getting too big and trying to do too much.

Turning to IAMAS, MacCracken reported that IAMAS has 10 disciplinary commissions, three of which met in 2004. The next IAMAS meeting will be held in 2005 in Beijing just before the IABO/IAPSO meeting; it will be paired with the PAGES Open Science Meeting. The next IAMAS General Assembly will be held as a joint IAMAS/IAPSO meeting in 2009. The International Commission of Snow and Ice is on course to become a new association of IUGG. (The association, to be decided upon at the IUGG General Assembly in Perugia in 2007, is tentatively to be named the International Association of Cryospheric Sciences.)

7.2.3 International Association for the Physical Sciences of the Oceans (IAPSO)

SCOR will meet in 2005 in conjunction with the IAG/IAPSO/IABO assembly in Australia. SCOR and IAPSO jointly submitted proposals to the U.S. Office of Naval Research and the U.S. National Science Foundation for the WG 121 conference, which were approved. IAPSO is a

partner with SCOR and LOICZ on WG 122. SCOR is also providing travel support for IAPSO's International Workshop on Forecasting and Data Assimilation in the Benguela and Comparable Systems, to be held in Cape Town, South Africa in November 2004.

Paola Rizzoli, Past-President of IAPSO, gave a report on IAPSO activities. IAPSO has been very active and is making good progress with IABO and IAG on plans for the Cairns meeting. Rizzoli described other IAPSO activities. In 2001, IAPSO began a process to revitalize the organization. A strategic plan was developed by Rizzoli and Vere Shannon, which required revising IAPSO's by-laws; this process is ongoing. Rizzoli reviewed plans for the Cape Town workshop to be held in November 2004. This workshop will result in a peer-reviewed publication. IAPSO might propose two joint working groups with SCOR in 2005, the first to revise the equation of state of seawater for which Dr. John Gould is taking the lead; the second on Deep Ocean Exchanges with the Shelf (DOES), one of the scientific priority areas identified in the IAPSO Strategic Plan for the new millennium, for which Dr. John Johnson is taking the lead.

7.3 Affiliated Programs

The benefit of continued affiliation to SCOR is evaluated at each General Meeting. Reports are provided at Executive Committee meetings for information only. All of these programs were invited to send representatives to the project coordination meeting sponsored by SCOR.

7.3.1 Census of Marine Life (CoML)

Akira Taniguchi, the Executive Committee reporter for CoML noted that CoML affiliated to SCOR in 2002. Taniguchi introduced Ron O'Dor, the CoML Senior Scientist. O'Dor reported that 2003 featured the CoML launch meeting and release of the CoML *Baseline Report*, which defines the known, unknown, and unknowable for different systems. The ultimate goal of CoML is to describe what did live (History of Marine Animal Populations [HMAP]), lives (CoML field projects), and will live (Future of Marine Animal Populations [FMAP]) in the ocean. The Ocean Biogeographical Information System (OBIS) will be the repository for data from CoML projects. SCOR's new panel on New Measurement Technologies for Observing Marine Life will be a scientific advisor to the CoML projects.

HMAP has implemented projects worldwide to analyze historical data on marine animal populations. FMAP work has been focused so far on creating baselines of what fishery records can tell us about population levels of large marine animals in the past, in order to predict what might occur in the future. The CoML field projects are based on the premise that the ocean is still greatly undersampled, particularly the deep ocean. (99.9% of OBIS records are for organisms found shallower than 3000 meters.) Coastal seas have been relatively well explored, so CoML activities in these areas focus on documenting the distribution and abundance of marine organisms. For deeper ocean areas, CoML projects are also studying diversity and discovering new organisms, in addition to documenting distribution and abundance. Because there are not enough taxonomists to study diversity using morphological approaches, CoML is

promoting the development of molecular techniques to study marine organisms, such as “barcode of life” activities, which involve molecular taxonomy based on specific segments of the ribonucleic acid (RNA) or deoxy-ribonucleic acid (DNA) of organisms.

There are presently 10 approved CoML projects, with four more under consideration:

- NaGISA—This project is studying biodiversity in the nearshore region by doing systematic sampling. It started in the Pacific Ocean region, but is now being implemented elsewhere also. Collections are done primarily by scuba divers. When samples are analyzed by molecular techniques, the data could contribute to GOOS.
- POST—This project involves tagging of salmon and sturgeon with acoustic tags and then tracking their migrations through lines of acoustic receivers across the continental shelf of the northwestern U.S. coast, western Canada, and Alaska.
- GoMA—“The goal of the Gulf of Maine Area Program is to gain enough knowledge to enable ecosystem-based management in a large marine environment within ten years. The Program will advance knowledge of both biodiversity and ecological processes over a range of trophic levels, from microbes to the top predators in the system.”⁹ This project is using historical fisheries information as well as new data from high-frequency coastal CODAR radars to provide a four-dimensional view of life in the Gulf of Maine coastal region.
- Continental Margins (CoMargE)—This project focuses on biodiversity on continental slopes and is being conducted in collaboration with the Hermes program, part of the European Union’s 6th Framework Program. The project obtains much of its information from oil companies.
- CeDAMar—“The general objective of CeDAMar is ‘the documentation of actual species diversity of abyssal plains as a basis for global change research and for a better understanding of historical causes and actual ecological factors regulating biodiversity’.”¹⁰
- ChEss—This project is exploring chemosynthetic ecosystems worldwide, which include areas of venting or diffusion of hydrogen sulfide, hydrocarbons (methane), and ammonia-rich hypersaline fluids, and diffusion of lipids from dead whales. Vent and seep areas are rare habitats in the deep sea. Like seamounts, chemosynthetic habitats feature a high level of endemism although, unlike seamounts, the species diversity is usually low.
- Census of Marine Life on Seamounts (CenSeam)—There may be more than 100,000 seamounts worldwide and only about 250 have been sampled, with only 90 sampled adequately. Biological exploration of seamounts has resulted in the discovery of many new species and indicates that seamounts tend to have high diversity and high endemism.
- MAR-ECO—This project is focused on the Mid-Atlantic Ridge, particularly the Charles-

⁹ <http://www.usm.maine.edu/gulfmaine-census/>

¹⁰ <http://www.cedamar.org/>

Gibbs Fracture Zone. The project has collected 50 species of cephalopod, some of which were not named previously. The ship *G.O. Sars* from Norway has been the primary research platform. A second ship was provided by NOAA for deep trawling. They have also used ROVs to investigate interesting features. Annelies Pierrot-Bults noted that the MAR-ECO cruises have made it possible to compare sampling with different kinds of nets and to combine net sampling with ROV observations.

- Tagging of Pacific Pelagics (TOPP)—This project focuses on tagging large fish, marine mammals, sea birds, and turtles to study their migrations and to understand what influences these migrations. These tags provide data similar to that from Argo floats, but they sample differently because they are not passive drifters and can cross frontal zones and target biologically significant features of the ocean.
- Arctic Ocean Biodiversity (ArcOD)—This project focuses on the least-studied ocean, which is understudied because most parts of it are covered by sea ice year-round. However, large parts of the Arctic Ocean may be ice-free during the summers as soon as 2030, which could have significant impacts on marine ecosystems. There is good collaboration in this project among German, Canadian, Russian, and U.S. scientists.
- Census of Antarctic Marine Life (CAML)—This project will study life in the Southern Ocean, particularly during the International Polar Year. It will focus on inventories of species (Antarctic fauna of slopes and abyssal plains, benthic fauna under disintegrating ice shelves, and plankton, nekton and sea-ice biota, and defining critical habitats for top predators.
- International Census of Marine Microbes (ICoMM)—This project will use “environmental genome shotgun sequencing” of genetic material found in seawater samples.
- Census of Marine Zooplankton (CMarZ)— CMarZ is a taxonomically comprehensive, global-scale census of marine zooplankton, to produce accurate and complete information on species diversity, biomass, and biogeographical distributions. CMarZ will analyze the ~6,800 described species—and will likely discover at least this many new species—of marine metazoan and protozoan holozooplankton by 2010.
- CReefs—This is a new CoML project that will document the diversity of coral reefs worldwide.

CoML implementation committees have been formed in many nations and regions. CoML has been pleased to have technology advice from SCOR Working Group 118 on New Technologies for Observing Marine Life.

OBIS has reached the level of five millions records, one year ahead of schedule. O’Dor said that the report of the SCOR-IGBP Liverpool meeting (see Section 4.3.3) will be given to CoML projects.

7.3.2 International Antarctic Zone (iAnZone) Program

Roberto Purini, the Executive Committee Reporter, reported that the next biennial iAnZone meeting will be held in Venice in October 2005. iAnZone has been well organized. Colin Summerhayes reported that SCAR has made iAnZone an affiliated project to SCAR.

During 2003 there was some debate about whether there was still a need for iAnZone as an international coordinating body. The remit of the newly formed CLIVAR/CliC Southern Ocean Panel included coordinating science of relevance to climate in the Southern Ocean. With some overlap of membership between iAnZone and the Southern Ocean Panel, it was felt that the community was suffering from meeting overload, and (to quote iAnZone's Report to SCOR in June 2003), "other programmes stand poised to take over some of the functions filled by iAnZone". This was the prevailing view of iAnZone members going into the Southern Ocean Science Week at Bremerhaven in September 2003, where meetings of the iAnZone Steering Committee and the Southern Ocean Panel were held along with other science meetings.

However, at the Southern Ocean Panel meeting directly preceding the iAnZone meeting, it quickly became apparent that the Panel is neither interested in, nor suited for, taking on the sort of coordination that has been carried out in the past by iAnZone. It was clear that the two bodies have a very complementary role: the Southern Ocean Panel will encourage and endorse activities, whereas iAnZone will be the tool through which the coordination of international efforts in the region can be achieved. CLIVAR felt that such a coordinating role was important and that iAnZone was a suitable organization to continue in this role. Furthermore, with the International Polar Year (IPY) coming up in 2007-2008, it was felt that the need for iAnZone is even stronger.

Current scientific activities of iAnZone include the Antarctic Slope (ANSLOPE) project and the Ice Station Polarstern (ISPOL-1) field programme. ANSLOPE seeks to define the roles of the Antarctic slope front and continental slope morphology in the exchanges of mass, heat and freshwater between the shelf and oceanic regimes. Emphasis is on processes that control deep-reaching outflows of shelf water mixtures in the Ross Sea. ISPOL-1 will take place during austral spring-summer of 2004-2005. It will use the concept of a manned drifting station to study spring-to-early summer ocean and sea ice conditions along the western Weddell Sea outer continental shelf and upper slope region. iAnZone is planning a major circumpolar study of the freshwater budgets and processes associated with the Antarctic Slope Front and coastal current (tentatively named AnzFront), scheduled for 2007-2008 as a contribution to IPY. Such a frontal study would link well with a corollary study of Arctic circumpolar frontal systems.

7.3.3 International Marine Global Changes Study (IMAGES)

Roberto Purini, the Executive Committee Reporter for IMAGES, reported that the project is also proceeding well. Laurent Labeyrie added that IMAGES will help understand how the interglacial ocean has been able to accumulate so much CO₂, in part through activities of SCOR/IMAGES WG 124's work on proxies for CO₂ levels in seawater. A major focus of IMAGES is how changes in insolation and ice cover affect ocean circulation. IMAGES is starting a specific group to contribute to IPCC. The project is preparing a glossy brochure to

summarize its scientific results. IMAGES is discussing the next chair for the IMAGES Executive Committee. The IMAGES IPO will remain at Bremen for two more years. IMAGES invests significant resources in data management.

IMAGES supports the activity of several IMAGES and SCOR-IMAGES working groups. There are currently seven active Working Groups, whose main task is to coordinate the acquisition of cores and laboratory data in key areas. Two new SCOR/IMAGES Working Groups, on the “*Reconstruction of Past Ocean Circulation (PACE)*” (SCOR/IMAGES WG 123) and on the “*Present Oceanic Processes and Paleorecords (LINKS)*” (SCOR/IMAGES WG 124) were formed in 2004. IMAGES and SCOR have co-funded the first meetings of these Working Groups in 2004. The other active IMAGES Working Groups include EPILOG: Re-evaluation of the LGM conditions, Southern Ocean, Icesheet-Ocean Interaction, Holocene Climate Variability, and PEPD: Past Equatorial Pacific Dynamics. A complete list of all former and still active working groups and their workshop reports can be found on the IMAGES Web site.

7.3.4 InterRidge - International, Interdisciplinary Ridge Studies

Laurent Labeyrie, the Executive Committee Reporter for InterRidge, reported on their progress. Labeyrie suggested that InterRidge should interact more with the community of scientists that study fluid flow in sediments and rocks, since heat fluxes at high pressures are efficient at putting heat into bottom waters. Labeyrie introduced Colin Devey, who became the InterRidge chair in 2004. Devey asked oceanographers to remember that there is a seafloor. The scientific purpose of InterRidge is to discover and quantify the inter-relationships among the various manifestations of the ridge system and to integrate growing understanding of ridge dynamics with knowledge about the functioning of the Earth in its entirety. These goals concern many subjects, from seismology to bacteriology, and require a variety of approaches at many different scales. To acquire global-scale data on the entire mid-ocean ridge system, international cooperation and planning is a necessity. InterRidge plays a vital role to facilitate international cooperation and thereby pool resources and expertise to address complex scientific ridge-related questions.

InterRidge provides a means to coordinate research projects that provides significant added value to the member nations who are part of an international program. Workshops organized by InterRidge working groups result in a synthesis of international/multidisciplinary efforts that clearly identifies scientific questions and areas that require investigation, as well as write project plans on how best to address these problems.

Providing up-to-date information is a fundamental part of InterRidge office activities, and the latest results from cruises are available on the InterRidge Web site as well as distributed to more than 2700 scientists in the annual newsletter *IR News*. All relevant information obtained by the InterRidge office is available to the general community via the InterRidge Web site: <http://www.interridge.org>.

The second decade of InterRidge, which began on 1 January 2004, will focus on bringing more countries into the program, increasing the profile of the program among the general public, governments and funding agencies as well as fostering more sophisticated and long-term research projects.

InterRidge has recently participated in International Seabed Authority meetings and is trying to expand its membership beyond the current number of 27 nations. They may begin allowing organizational members. InterRidge is increasing its activities in the areas of education and outreach, such as establishing a “science writer at sea” program. InterRidge has a mid-ocean ridge ecosystems working group that has links with the CoML ChEss project. Toshitaka Gamo (Japan) noted that InterRidge has a good interaction with GEOTRACES. Another working group is working on ultraslow spreading ridges, such as the Arctic Ridge, which is a good place to test models of spreading. SCOR provided support for travel of a developing country scientist to an InterRidge meeting for the first time in 2004.

7.3.5 International Ocean Colour Coordinating Group (IOCCG)

John Field, the Executive Committee Reporter for IOCCG, opened the discussion of the project by informing participants that IOCCG involves agencies, scientists and users. Half are rotating members and the others are ex-officio members, representing participating organizations. IOCCG produces email newsletters and reports from its working groups. Field introduced Venetia Stuart, the IOCCG Executive Scientist, who made a presentation about IOCCG’s activities and plans. Stuart reviewed the history of IOCCG, its formation by IOC, and its affiliation with SCOR, and reported that IOCCG is moving its finances from being handled through SCOR to being handled through POGO (mostly). Stuart presented the aims of IOCCG and reviewed its membership. There are currently 20 members. Three members and the chair, Trevor Platt, will rotate off after its next meeting. IOCCG carries out its work primarily through scientific working groups, which produce reports, including the following:

- **IOCCG Report Number 1:** *Minimum Requirements for an Operational Ocean-Colour Sensor for the Open Ocean*
- **IOCCG Report Number 2:** *Status and Plans for Satellite Ocean-Colour Missions: Considerations for Complementary Missions*
- **IOCCG Report Number 3:** *Remote Sensing of Ocean Colour in Coastal, and Other Optically-Complex, Waters*
- **IOCCG Report Number 4:** *Guide to the Creation and Use of Ocean-colour, Level-3, Binned Data Products*

Current IOCCG working groups include

- Calibration of Ocean-Colour Sensors
- Coordination of Merged Data Sets
- Comparison of Atmospheric Correction Algorithms
- Operational Ocean Colour

- Ocean-Colour Algorithms
- Global Ecological Provinces
- Ocean-Colour Remote Sensing in the Coastal Zone

IOCCG conducts a variety of capacity-building initiatives, including fellowships, workshops, lecturerships, and training courses and cruises. IOCCG benefits from affiliation to SCOR because it helps increase IOCCG's credibility, provides an intellectual home for IOCCG, efficient coordination with other organizations, and a vehicle to help transfer funds to IOCCG.

John Field commented that IOCCG is a good group, and that it is timely to rotate the chair. Laurent Labeyrie stated that the IOCCG Web site is an important portal for ocean color information. Ron O'Dor suggested that there might be an opportunity to add optical sensors to the CoML POST array to provide in-situ calibration for satellite ocean color sensors. Ed Urban asked whether IOCCG has ever written an article, for example, for *EOS*, that would inform the broader community of IOCCG reports like the report on Case 2 waters, *Remote Sensing of Ocean Colour in Coastal, and Other Optically Complex Waters* in 2000. Urban has heard comments from the community that seem to indicate that they are not aware of this report. Stuart responded that IOCCG has not done an *EOS* article about this report. John Field commented that ocean color is the technology that has most revolutionized biological oceanography in the past decade. Having a group like IOCCG that ensures the quality of the data has been a tremendous service; they play a very valuable role.

7.3.6 Sunsets on Project Affiliations

The advantages and disadvantages of keeping the 10-year affiliation sunset were discussed. IOCCG would prefer that the sunset be eliminated because IOCCG still benefits from its affiliation to SCOR, as noted above. Laurent Labeyrie added that IMAGES has the same reasons for wanting to eliminate the sunset clause. Duce stated that he understands the value of eliminating the sunset periods. The Executive Committee decided to eliminate the sunset as a general rule, while still regularly evaluating the benefits of affiliation to the projects and to SCOR.

7.4 Other Organizations

7.4.1 Partnership for Observation of the Global Ocean (POGO)

The most recent POGO meeting was in Yokohama, Japan and Akira Taniguchi represented SCOR at that meeting. The next POGO meeting will be held in Brest, France on 29 Nov.-1 Dec. 2004. John Field is the SCOR liaison to POGO. He had no additional comments to add to the discussion. Field will attend the next POGO meeting and will represent SCOR there, even though he will no longer be a member of the SCOR Executive Committee. POGO has expressed its thanks to SCOR for continued support.

8.0 ORGANIZATION AND FINANCE

8.1 2004 Election of SCOR Officers

John Field reviewed the nominations received for new SCOR officers. The Nominating Committee considered expertise, geographic balance, and gender. Robert Duce (President), John Field (Past-President), and Roberto Purini (Vice-President) have completed their allowed terms. Laurent Labeyrie (Vice-President) and Akira Taniguchi (Vice-President) are eligible for re-election. SCOR received one nomination for president (Bjorn Sundby [Canada]), and four for Vice-President (Victor Akulichev [Russia], Laurent Labeyrie [France], Akira Taniguchi [Japan], and Ilana Wainer [Brazil]). No objections were received from SCOR national committees, so Bjørn Sundby began his term as the new SCOR President at the end of the meeting. Akira Taniguchi, Laurent Labeyrie, and Victor Akulichev were elected as Vice Presidents. In addition to the officers, the Nominating Committee recognized the need for better representation from developing countries and for gender balance and they recommended that Ilana Wainer be co-opted to the Executive Committee for another two-year term, which was approved.

8.2 Membership

8.2.1 National Committees

Ed Urban met with the French SCOR Committee in May 2004, following the symposium on The Ocean in a High-CO₂ World. Korea and Ireland communicated to SCOR in recent years that they were no longer interested in participating in SCOR and/or could not afford to do so, so they were removed from the list of SCOR national committees in 2004. Thailand has enquired about re-joining SCOR. Urban noted that there were many changes in Nominated Members in the past year, which he thinks is due to several of the national SCOR committees becoming re-activated.

8.2.2 National Members Moving to Suspended Status

The Executive Committee approved a procedure to change the status of members not paying their dues, to “Suspended Member” status, with fewer benefits. John Field reported that, at the end of 2004, Bangladesh and the Philippines are subject to a change in their status, since they have not paid dues in 2001-2004. Field recommended transferring them to Observer Member status, although meeting participants recommended that continued efforts be made to keep the Philippines as a paying member, as they might still have some ability to pay dues.

8.3 Publications Arising from SCOR Activities

SCOR projects have produced quite a few significant publications this year. The list maintained on the SCOR Web site does not include all publications from SCOR-sponsored projects; they can be obtained from the projects' Web sites.

Publications from Working Groups and Major Projects—WG 112 published a special issue of *Biogeochemistry* and WG 113 published a special issue of *Marine Geology*. GEOHAB published its *Implementation Plan* and SOLAS published its *Science Plan and Implementation Strategy* since the last SCOR meeting.

2003 *SCOR Proceedings*—The *Proceedings* was printed and distributed in August. Urban noted that the *Proceedings* took longer this year than he had intended, but that he would try to get the 2004 *Proceedings* published sooner after this meeting and would also circulate a short summary document after the meeting.

SCOR Brochure—The SCOR brochure is updated occasionally and given to potential sponsors, potential member nations, and others. The brochure is available in English, Spanish, and French. The SCOR brochure will be updated after the Venice meeting.

SCOR Web site—A request was made at the 2002 meeting to add scientific highlights related to SCOR activities. Highlights from GLOBEC and SOLAS are now linked to the SCOR Web site and others will be added as they are available. SCOR is providing Web site services for WG 121's conference and for IMBER and GEOHAB (until they have full IPOs). Links to meeting Web sites have been added to the SCOR Web site. It would help to include more information on the SCOR Web site from projects and the working groups.

SCOR Poster—The SCOR poster in A3 size was printed in May and distributed with the *SCOR Proceedings*. The SCOR poster in A0 size will be distributed to SCOR Executive Committee members.

8.4 Finances

The annual audit was performed in mid-February and Elizabeth Gross worked to prepare information for the auditors. The financial records and financial controls were found to follow accepted standards.

SCOR received two new grants from the Sloan Foundation this year, new grants from NSF and ONR, and annual increments to the SCOR science grant and developing country travel grant from NSF. New funding for GEOTRACES was added to the NSF science grant. NOAA has provided new funding for GEOHAB.

Birger Larsen chaired the ad hoc Finance Committee, which also included Marie-Alexandrine Sire and Victor Akulichev. The committee reviewed the 2003 and 2004 finances, and the budget for 2005. There were no critical comments regarding SCOR's 2003 finances, based on the audit reports and reports from the SCOR Secretariat. The 2003 surplus was largely due to late dues payments from Russia and France. Larsen noted that only about US\$300,000 of US\$1,000,000 of SCOR income is under SCOR's discretion to spend (discretionary funds). At

the 2003 meeting, it was recommended that SCOR maintain a reserve of US\$100,000; this was met in 2003. The committee recommended that the 2003 financial statements be approved, which they were (see 2003 statement in Annex 10).

The Finance Committee reviewed revisions to the 2004 budget. Changes in the income resulted from new funds raised by the SCOR Secretariat for SCOR activities since the budget was approved at the Moscow meeting. Some activities were more expensive than budgeted and some less expensive. The committee recommended that the suggested changes to the 2004 budget be approved. They project a surplus of US\$20,000 for 2004, for a year-end reserve of about US\$200,000. This is probably too high because it looks bad to the national committees when they apply for payment of dues.

Turning to 2005 finances, Urban explained the 2005 budget. The committee concluded that there is enough funding for two new working groups in 2005. This will create a budget deficit in 2005, but this is acceptable because of the large projected reserve at the end of 2004.

The committee recommended that dues for 2006 be increased by 1% for Category III, IV and V nations and that dues for Category I and II nations continue to be maintained at 2001 levels.

Robert Duce thanked the Finance Committee for their work during the meeting.

8.5 SCOR Incorporation

Ed Urban explained the background for SCOR's incorporation. ICSU requested that all ICSU bodies become incorporated separately, to reduce ICSU's potential financial liability. SCOR used its constitution as the official articles of incorporation (see Annex 5) and is now incorporated in the State of Maryland, USA.

8.6 Disciplinary Balance among SCOR Working Groups

Laurent Labeyrie presented an update on the disciplinary balance among working groups. He commented that up until two years ago there was a good balance, but there will now be an imbalance due to new biological groups approved this year. There are no groups dealing with benthic biology. In Earth sciences, we have nothing about interactions between the deeper Earth, margins, and the ocean. In chemistry, there is only one group. There are only two groups in physical oceanography. Because working group proposals arise from the community and national SCOR committees, SCOR cannot completely control the disciplinary balance, although SCOR can encourage working group proposals on topics that it thinks are most needed to maintain disciplinary balance. There was much discussion about Labeyrie's classification of individual activities: GEOTRACES, WG 124, and IMBER also include chemistry.

John Field suggested that the call for new working groups include information on the problems of disciplinary balance, identifying physical and perhaps chemical oceanography as areas needing attention. Labeyrie suggested that we can redress the balance within one or two years. Paola Rizzoli offered IAPSO's help. Bjørn Sundby commented that defining things only on disciplinary lines can be restrictive. Should we ask for working group proposals related to IPY? Hein de Baar responded that the proposed SCAR/SCOR Expert Group on Oceanography will be another mechanism for generating physical and polar working group proposals. Sundby added that the new discussions with IGBP might generate topics for which a SCOR working group would be helpful and for which some outside funding might be possible.

8.7 Impacts of Former SCOR Working Groups

Bjørn Sundby made a presentation about the impacts of prior working groups. He presented a list of SCOR working groups that have had major impacts, for example, books that have become a standard reference in the field or syntheses made by working groups that have had an impact. Not all working groups have been successful. The success of a working group depends critically on the chair, so the chair must be chosen with great care. Members must be told explicitly what is expected of them. The time line is important; working groups should be monitored carefully and produce annual progress and activity reports. Urban added that the longer a working group goes on, the more likely it is to fail. In terms of the visibility of SCOR products, one chair was frustrated because the group's product didn't get much visibility. Sundby stressed that we need to emphasize accessibility of SCOR products.

In summary, SCOR's system for generating and managing working groups is good. We have to ensure that working groups understand their responsibilities, but SCOR has a responsibility to ensure that products have a high visibility, for example, by putting the publications on the Web in pdf format. Laurent Labeyrie commented that SCOR has the strength to negotiate with publishers to make sure that publications get onto the Web. Ed Urban responded that the SCOR Secretariat is not usually involved in working group decisions regarding publications or negotiations with publishers. He would need to get more involved in the process to make sure the pdfs can be posted. Hein de Baar commented that he managed to convince Elsevier to let his institute retain the copyright for a couple of books. Perhaps SCOR could do this and then put the publications on the Web. Robert Duce commented that Sundby and Urban should incorporate the main points of Sundby's review into working group procedures for the future. Sundby concluded that the system isn't broken, so we don't need to fix it in any substantial way.

8.8 SCOR Secretariat Personnel Actions

8.8.1 Hiring of New Administrative Secretary for SCOR Secretariat

Ed Urban reported that Phyllis Steiner was hired in November 2003 as the half-time Administrative Secretary for the SCOR Secretariat and is doing an excellent job.

9.0 SCOR-RELATED MEETINGS

9.1 SCOR Annual Meetings

The Executive Committee considered potential locations in which to hold future meetings, particularly in nations that have not recently hosted annual meetings.

9.1.1 2004 General Meeting – Venice, Italy

Robert Duce thanked Robert Purini and Paola Rizzoli for suggesting that SCOR hold its 2004 General Meeting in Venice and for making the meeting a memorable event. He also thanked Jane Frankenfield Zanin for the excellent local support and arrangements she provided for the meeting.

9.1.2 2005 Executive Committee Meeting – Cairns, Australia

SCOR has received an official invitation from the Australian Academy of Sciences to meet in Australia following the IAG/IAPSO/IABO meeting in August 2005. The SCOR meeting will be held in Cairns from August 29 to September 1.

9.1.3 2006 General Meeting – Concepción, Chile

The Chilean SCOR Committee has informally offered to host the 2006 General Meeting in Chile. Roberto Garnham made a short presentation about the benefits of meeting in Chile and made a formal invitation for SCOR to hold its 2006 General Meeting in Concepción. SCOR accepted the invitation.

9.1.4 2007 Executive Committee Meeting

Since the 50th Anniversary Meeting was shifted to 2008, a new location must be found for the 2007 meeting. The SCOR President and Executive Director will identify potential meeting locations before the 2005 SCOR meeting.

9.1.5 2008 General Meeting -- SCOR 50th Anniversary— Woods Hole, Massachusetts, USA

The Executive Committee has agreed to hold its 2008 meeting in Woods Hole to celebrate SCOR's 50th Anniversary, since Woods Hole was the site of the first SCOR annual meeting, in 1957. The meeting will include some kind of symposium or session that will look backward and/or forward. A planning committee was formed for the meeting. This committee will be chaired by Robert Duce (USA) and will also include Elizabeth Gross (USA), Laurent Labeyrie (France), Annelies Pierrot-Bults (The Netherlands), and Vere Shannon (South Africa). Fred Grassle, chair of the CoML SSC, will participate in the planning. The committee will work by email and will report back at the 2005 SCOR Executive Committee Meeting in Australia.

9.2 Other Meetings of Interest to SCOR

Other SCOR-related meetings are listed on the SCOR Web site and in Annex 11.

ACRONYMS

AGU	American Geophysical Union
AICI	Air-Ice Chemical Interactions (SOLAS and IGAC)
AnZFront	Antarctic Slope Front and coastal current study (iAnZone)
ANSLOPE	Antarctic Slope study (iAnZone)
APN	Asia Pacific Network for Global Change Research
ArcOD	Arctic Ocean Biodiversity (CoML)
ASLO	American Society for Limnology and Oceanography
BCLME	Benguela Current Large Marine Ecosystem
BIOMASS	Biological Investigations of Marine Antarctic Systems and Stocks (SCOR and SCAR)
CACGP	Commission on Atmospheric Chemistry and Global Pollution (IAMAS)
CalCOFI	California Cooperative Oceanic Fisheries Investigations
CAML	Census of Antarctic Marine Life (CoML)
CCAMLR	Convention on the Conservation of Antarctic Living Marine Resources
CCC	Cod and Climate Change (ICES and GLOBEC)
CCCC	Climate Change and Carrying Capacity (PICES and GLOBEC)
CenSeam	Census of Marine Life on Seamounts (CoML)
CFAME	Climate Forcing and Marine Ecosystem (GLOBEC CCCC)
ChEss	Chemosynthetic Ecosystems project (CoML)
CLIOTOP	Climate Impacts on Ocean TOP Predators (GLOBEC)
CLIVAR	Climate Variability and Prediction project (WCRP)
CMarZ	Census of Marine Zooplankton (CoML)
CNR	Consiglio Nazionale delle Ricerche (Italy)
COASTS	Coastal Ocean Advanced Science and Technology Studies (IOC)
CoML	Census of Marine Life
COOP	Coastal Ocean Observations Panel (GOOS)
COPEs	Coordinated Observation and Prediction of the Earth System (WCRP)
CPR	Continuous Plankton Recorder
CRP	Core Research Project (GEOHAB)
DNA	deoxy-ribonucleic acid
DOES	Deep Ocean Exchanges with the Shelf (DOES)
EGU	European Geophysical Union
ESSAS	Ecosystem Studies of Sub-Arctic Seas (GLOBEC)
ESSP	Earth System Science Partnership (IGBP, WCRP, IHDP, and DIVERSITAS)
EU	European Union
FAO	Food and Agriculture Organization (UN)
FEMS	Federation of European Microbiology Societies
FMAP	Future of Marine Animal Populations (CoML)

GCN	Global Coastal Network
GCOS	Global Climate Observing System
GEBCO	General Bathymetric Chart of the Oceans
GECAFS	Global Environmental Change And Food Systems (ESSP)
GEF	Global Environment Facility
GEOHAB	Global Ecology and Oceanography of Harmful Algal Blooms program (SCOR and IOC)
GEOSS	Global Earth Observing System of Systems
GESAMP	Group of Experts on the Scientific Aspects of Marine Environmental Protection (UN)
GLOBEC	Global Ocean Ecosystem Dynamics project (SCOR, IGBP, and IOC)
GMA	Global Marine Assessment
GODAE	Global Ocean Data Assimilation Experiment
GOOS	Global Ocean Observing System
GRA	GOOS Regional Alliance
GRC	Gordon Research Conference
GTOS	Global Terrestrial Observing System
HAB	harmful algal bloom
HMAP	History of Marine Animal Populations (CoML)
IABO	International Association of Biological Oceanography (IUBS)
IAG	International Association of Geodesy
IAI	Inter-American Institute for Global Change Research
IAMAS	International Association of Meteorology and Atmospheric Sciences (IUGG)
iAnZone	International Antarctic Zone program
IAP	Inter-Academy Panel
IAPSO	International Association for the Physical Sciences of the Oceans (IUGG)
ICCED	Integrated analysis of Circumpolar Climate interactions and Ecosystem Dynamics
ICES	International Council for the Exploration of the Seas
ICoMM	International Census of Marine Microbes (CoML)
ICSU	International Council for Science
IGAC	International Global Atmospheric Chemistry project (IGBP and CACGP)
IGBP	International Geosphere-Biosphere Programme (ICSU)
IGFA	International Group of Funding Agencies for Global Change Research
IGOS	Integrated Global Observing Strategy
IHDP	International Human Dimensions of Global Change Programme (ICSU)
IMAGES	International Marine Global Changes Study (IGBP/PAGES)
IMBER	Integrated Marine Biogeochemistry and Ecosystem Research project (SCOR and IGBP)
IMP	Implementation Group (SOLAS)
IOC	Intergovernmental Oceanographic Commission (UNESCO)
IOCCG	International Ocean Colour Coordinating Group
IOCCP	International Ocean Carbon Coordination Project (SCOR and IOC)
IPCC	Intergovernmental Panel on Climate Change
IPO	international project office
IPY	International Polar Year
ISPOL-1	Ice Station Polarstern (iAnZone)
IUBS	International Union of Biological Sciences (ICSU)
IUGG	International Union of Geodesy and Geophysics (ICSU)

IUPAC	International Union of Pure and Applied Chemistry (ICSU)
IWC	International Whaling Commission
JGOFS	Joint Global Ocean Flux Study (SCOR and IGBP)
JMA	Japanese Meteorological Agency
JPA	Joint Programme of Activities (EUR-OCEANS)
JSC	Joint Science Committee (WCRP)
LINKS	WG on Analyzing the Links Between Present Oceanic Processes and Paleo-Records (SCOR and IMAGES)
LOICZ	Land-Ocean Interactions in the Coastal Zone project (IGBP and IHDP)
LME	large marine ecosystem
MAR-ECO	Mid-Atlantic Ridge project (CoML)
NaGISA	Natural Geography In Shore Areas (CoML)
NASA	National Aeronautics and Space Administration (U.S.)
NERC	Natural Environmental Research Council (U.K.)
NEXT	Nemuro Experimental Planning Team (GLOBEC/PICES CCCC)
NIWA	National Institute of Water & Atmospheric Research Ltd. (New Zealand)
NOAA	National Oceanic and Atmospheric Administration (USA)
NoE	Network of Excellence (E.U.)
NPESR	North Pacific Ecosystem Status Report (GLOBEC/PICES CCCC)
NSF	National Science Foundation (USA)
OASIS	Ocean-Atmosphere-Sea Ice-Snow project
OBIS	Ocean Biogeographic Information System (CoML)
OFCCP	Oceanic Fisheries and Climate Change Project
OOPC	Ocean Observations Panel for Climate (GCOS)
OPC	optical particle counter
OSM	open science meeting
PAA	Priority Area Assessment (ICSU)
PACE	WG on Reconstruction of Past Oceanic Circulation (SCOR and IMAGES)
PACKMEDS	Physics and Chemistry as the Key to Marine Ecosystem Dynamics and Structure (SCOPE, IAPSO, and SCOR)
PAGES	Past Global Changes project (IGBP)
PICES	North Pacific Marine Science Organization
PML	Plymouth Marine Laboratory (UK)
POGO	Partnership for Observations of the Global Oceans
RCOOS	Regional Coastal Ocean Observing Systems
RNA	ribonucleic acid
SAGE	SOLAS-ANZ Dual Tracer Gas Exchange Experiment
SAHFOS	Sir Alistar Hardy Foundation for Ocean Sciences (UK)
SCAR	Scientific Committee on Antarctic Research (ICSU)

SCOPE	Scientific Committee on Problems of the Environment (ICSU)
SCOR	Scientific Committee on Oceanic Research (ICSU)
SERIES	Subarctic Ecosystem Response to Iron Enrichment Study (SOLAS)
SOLAS	Surface Ocean-Lower Atmosphere Study (SCOR, IGBP, WCRP, and CACGP)
SPACC	Small Pelagic fish and Climate Change project (GLOBEC)
SP/IS	Science Plan/Implementation Strategy
SSC	scientific steering committee
TOPP	Tagging of Pacific Pelagics (CoML)
TOS	The Oceanography Society
TWAS	Third World Academy of Sciences
TWNSO	Third World Network of Scientific Organizations (TWAS)
TWOWS	Third World Organization for Women in Science (TWAS)
UNESCO	United Nations Educational, Scientific, and Cultural Organization
WCRP	World Climate Research Programme (WMO, IOC, and ICSU)
WG	working group
WMO	World Meteorological Organization
WOCE	World Ocean Circulation Experiment (WCRP)
WSSD	World Summit on Sustainable Development

Annex 1

Agenda for 2004 SCOR General Meeting

	Monday, Sept. 27	Tues., Sept. 28	Wed., Sept. 29	Thurs., Sept. 30
9:00	Introductions and Logistics Approval of Agenda	Other Activities	ICSU WCRP	IGBP
9:15	President's Report		SCAR and IPY	
9:30	Exec. Dir.'s Report	Current WGs		
9:45	Appointment of Ad Hoc Finance and Disciplinary Balance Committees			
10:00	Report from Nominating Committee			
10:15	Disbanded WGs			
10:30	BREAK	BREAK	BREAK	BREAK
11:00	GOOS (OOPC & COOP)	WG Proposals	Presentation(s) about Venice Lagoon	IOCCG
11:15				
11:30				
11:45				
12:00	Report from Data Management and Project Coordination Meeting			Organization and Finance Membership Publications Finances
12:15				
12:30	LUNCH	LUNCH	LUNCH	LUNCH
14:00	GLOBEC	WG Proposals (cont.)	Visit to Venice Lagoon Physical Model	Organization and Finance (cont.)
14:15				
14:30	GEOHAB			Report of Ad Hoc Disciplinary Balance Committee
14:45		SCOR-Related Meetings Other Business		
15:00	SOLAS	Capacity Building		Executive Committee (closed session)
15:15				
15:30	BREAK	BREAK		
15:45				
16:00	IMBER	Third World Academy of Sciences		
16:15				
16:30	GEOTRACES	IOC GESAMP		
16:45				
17:00	LOICZ			
17:15				
17:30	Ocean Carbon	PICES		
17:45				
18:00				

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Annex 3

Proposal for a SCOR Working Group on Global Comparisons of Zooplankton Time Series (revised January-March 2005 based on feedback from SCOR Executive)

1. Background & Rationale

There is an increasing scientific and public focus on how climate variability and climate trends affect marine ecosystems. Important scientific questions include the qualitative character of the ecosystem responses (“what changes”), their amplitudes (“by how much”), and their timing and spatial and temporal scales (“when and where are rates of change strongest”). There is much accumulated evidence that living marine resources in individual ocean regions undergo strong, and sometimes abrupt, changes in stock size and productivity at roughly decadal intervals. This variability is associated with corresponding changes in the atmosphere, and in physical oceanographic, and lower trophic-level biological processes and state variables. However, in general we do not know the mechanisms by which these changes occur, the relative importance of direct physical forcing vs. biological interactions, and if the dominant mode of biological feedback is “bottom-up”, “top-down”, or “wasp-waist” (Verheye and Richardson, 1998, Cury et al., 2000, Tadokoro et al., in press). Nor do we know how to anticipate the timing and direction of the next major shift.

Perhaps the most provocative and influential example of large-scale, multi-year marine ecosystem variability has been the similarity in duration and phasing of major fluctuations in sardine and anchovy catch in widely separated boundary current systems (e.g., Kawasaki et al., 1991; SCOR WG98 “Worldwide large scale fluctuations of sardine and anchovy populations” and Schwartzlose et al., 1999; the ongoing SPACC research program).

We are forming a SCOR Working Group to do a similar global-scale comparison of low-frequency variability of marine zooplankton communities. This idea grew out of a workshop convened by Ian Perry and Hal Batchelder during the recent “3rd International Zooplankton Production Symposium” (May 2003 in Gijon, Spain, co-sponsored by GLOBEC, PICES, ICES and the Spanish government). A summary paper from that workshop (Perry et al., 2004) includes preliminary, but provocative, evidence for temporal coherence of zooplankton and climate variability in both the North Atlantic and the North Pacific (Fig. 1). There was a strong consensus at the Gijon workshop that a more detailed and more global comparison of zooplankton time series would be timely, technically feasible, and extremely useful.

Such an analysis must be an international cooperative effort – the relevant data sets are in many places and have been collected by many independent nations and agencies. However, many of the necessary data are available now, and the Working Group can begin immediately. We have strong grass-roots commitment by many participating scientists. Endorsement and sponsorship by SCOR will help us attract and retain approvals and financial support from senior national agencies. We also expect to attract co-sponsorship and additional financial support in the form of travel funding for associate WG members (probably 3-5) from PICES, ICES, Census of Marine Life, and the national and international GLOBEC programs. We have been in preliminary contact with most of these organizations and programs (as of January 2005). They agree with the need for such a group, and have confirmed their interest in and support for the activity.

2. The nature of the scientific opportunity

Why zooplankton?

For several reasons, multi-year zooplankton time series provide useful tools for examining climate-ecosystem interactions. First, mesozooplankton (about 0.1-2 cm body length) are a key link between primary producers and larger predators. Second, mesozooplankton are abundant, and can be quantified by relatively simple and intercomparable sampling methods. Third, and perhaps most important, demographic traits of zooplankton make them particularly suitable for analysis of interannual ecosystem changes. Life cycles of most species range from a few months to one year. Recruitment and mortality rates are slow enough that major population fluctuations are not missed by sampling at ~monthly intervals. But (unlike most fish and marine mammals) changes in population size are rapid enough to track seasonal-to-interannual changes in environmental conditions. Fourth, because few zooplankton taxa are fished, most zooplankton population changes can be attributed to environmental causes. Finally, because many fish are dependent on a zooplankton food source during their pre-recruit life history stages, zooplankton anomalies may be a useful leading indicator of what will happen to commercial fish stocks several years later (for two striking examples, see Batchelder et al., 2002 and Beaugrand et al., 2003).

Availability and diversity of zooplankton time series

Zooplankton time series of ten years or more in length are now available for many widely separated ocean regions (Table 1 from Perry et al., in press). The longest are the Continuous Plankton Recorder (CPR) surveys of the eastern North Atlantic (80+ years); the California Cooperative Fisheries Investigations (CalCOFI) surveys of the south-central California Current system (50+ years); Canadian and Japanese sampling in the subarctic NE Pacific (50+ years summer season, continuous 1958-1981); Japanese, Russian and Korean collections from the western margin of the Pacific and the Asian marginal seas (40-50+ years); sampling by IMARPE (Peru), IFOP (Chile) and other agencies in the Peru-Chile upwelling region (~40 years); U.S. and Canadian monitoring programs in the coastal NE Atlantic (~40 years); and several ongoing European sampling programs in the North Sea and Mediterranean Sea (20-30 years). In several additional ocean regions (notably off South Africa and in the Arabian Sea) it may be possible to assemble very long time series by combining information from sequences of shorter observation programs.

Many important within-region analyses of these zooplankton time series have been completed, and are being widely noted by both the scientific community and by decision makers (e.g., Brodeur and Ware, 1992; Roemmich and McGowan, 1995; Beaugrand et al., 2003; Edwards and Richardson, 2004).

Recurrent themes have been that

- multi-year variability of zooplankton is large enough to be significant both statistically and ecologically,
- variability at the level of individual species or species guilds (when quantified) is often stronger than the variability of aggregate measures such as total biomass, and
- there are many clear correlations of the interannual zooplankton variability with both the physical environment and with the distribution and productivity of harvested fish stocks.

There is growing evidence that zooplankton time series that go beyond biomass to include plankton compositional information are especially useful. In part this is because interannual-decadal changes in community composition, phenology (seasonality of life history events), and physiological “condition” are often very strong. However, composition-resolved time series also have greater information content and

interpretability because they invite cross-referencing to large-scale distributions, physiology, predator-prey associations and behavioral and life-history strategies. Many new and ongoing time series are therefore now adding a compositional component (e.g., “zooplankton species” is on the OCEAN.US IOOS list of core variables). For the historic biomass time series, this compositional information is often still available in the form of “samples in jars”. Re-processing of older archived samples is underway in several regions (e.g., CalCOFI retrospective studies in U.S. GLOBEC; the Odate Project in Japan; and BENEFIT and BCLME programs in the southeast Atlantic, recent IAI/EPCOR funding for workup of Peru Current samples and data). We will include data from these re-analyses in our Working Group’s comparison effort. A showpiece demonstration of value would do much to attract new funding for broader re-processing efforts.

The case for global comparisons

We believe that large-scale (between-region and between-ocean) comparisons of zooplankton time series are the essential next step. The sardine-anchovy story provides one clear example of how such a comparison can stimulate scientific progress. However, both similarities and differences between time series will be informative. If we do find that zooplankton variability has a very large spatial “footprint” (global- to basin-scale coherence of type and/or timing, as suggested in Fig. 1), this will be very strong evidence that causal mechanism(s) are also large scale. Conversely, smaller-scale forcing mechanisms that are confounded (either temporarily or permanently) within a single region often vary independently or inversely in other regions, allowing statistical discrimination. Third, because individual time series show serial autocorrelation, statistical degrees of freedom accumulate slowly—it takes a very long time to discriminate differences in strength and stability among local correlative associations. Between-region comparisons allow a form of ensemble averaging that is quicker and also very effective for testing the consistency and basis of association.

To date, relatively few between-region comparisons of zooplankton time series have been completed. All have been at much less than global scale (within an individual current system, or at most one ocean basin). Almost all of the basin-scale comparisons (with the notable exception of the CPR surveys) have been confined to estimates of total mesozooplankton biomass or biovolume. We now have access to both the data and the tools needed to carry out a global synthesis.

Methodological opportunities and issues

Several methodological issues affect the analysis of zooplankton time series. We have space here for only a brief summary (more detailed discussion is available in Perry et al., 2004). However, our overall assessment is that these issues will complicate our work, but not prevent a useful global comparison. The first issue is diversity of sampling methodology. No zooplankton sampling method is perfect, and there have been differences in sampling methodology both within and between data sets. However, we do not expect these differences to be a serious technical barrier to between-region comparisons. One key reason is that our analysis focuses on comparisons of anomaly time series rather than of the regional climatologies—we are primarily interested in the temporal variability of relative abundance, not the spatial variability of absolute abundance. As practicing zooplankton field ecologists, Working Group members also are in a good position to recognize problem situations and taxa. Several of the proposed WG members have expertise in evaluating effects of sampling method changes within individual time series. We will also keep close liaison with SCOR WG 115 on Standards for the Survey and Analysis of Plankton through one shared member, Hans Verheye.

A second issue is consistency of taxonomic identification within and among data sets. Again, we are helped by the fact that we are primarily comparing anomalies relative to local norms, and looking for when, where, and how long the community changes. We also expect that all or most of our analyses will be weighted on the better-known taxa that dominate the community in each region.

A third issue is the volume, accessibility, and diversity of data. The situation here is much better than it was even a few years ago. Several key data sets have already been put in readily accessible form. Good computer tools for dealing with diverse-origin and moderately large data sets are now more available, cheaper, and more flexible and user friendly. We anticipate that this trend will continue. Although data management work will be necessary, we do not expect that electronic assembly and consolidation of the zooplankton data sets will be a major technical problem.

The final issue is the diversity of visualization and statistical tools that have been applied in previous regional zooplankton analyses. Our intent is to use this diversity rather than try to eliminate it. We will apply a range of analytical tools and evaluate the degree to which they are effective, redundant, or complementary. As with data archival and formatting, many of the necessary tools are becoming much more available and user friendly. Other important practices and concepts, such as how to deal with temporal and spatial autocorrelation, and with data gaps, are not yet familiar to many zooplankton ecologists. Demonstration, evaluation, and perhaps packaging of these tools will be another important WG product.

3. Proposed terms of reference

- Identify and consolidate a globally representative set of “long zooplankton time series” (selected from the data sets listed in Table 1, plus perhaps from additional regions for which time series can be pieced together from a sequence of shorter programs).
- Facilitate migration of individual data sets to a permanent and secure electronic archive (Requirements for development of a fully stocked zooplankton database greatly exceed the resources of this WG. However, we expect to produce a small working prototype, based on the present U.S. NMFS “Copepod” archive. We also expect that our WG activities will demonstrate the value of sharing data through an international database.)
- Develop and share protocols for within-region and within-time-period data summarization (e.g., spatial, seasonal and annual averaging, summation within taxonomic and age categories). The goal is to learn what level of detail provides the optimal tradeoff or information gain vs. processing effort.
- Based on the above, develop priorities and recommendations for future monitoring efforts and for more detailed re-analysis of existing sample archives.
- Once regional data sets are compiled and collated, carry out a global comparison of zooplankton time series using (in parallel) a diverse suite of numerical methods. We will examine
 - Synchronies in timing of major fluctuations, of whatever form.
 - Correlation structure (scale and spatial pattern) for particular modes of zooplankton variability (e.g., changes in total biomass, replacement of crustacean by gelatinous taxa, alongshore or cross-shore displacements of zoogeographic distribution boundaries).
 - Amplitude of variability, both for total biomass and for individual taxa, and comparison to the amplitude of population fluctuations of predator species (fishes, seabirds, marine mammals). Is there amplification at higher levels of the food web?

- Likely causal mechanisms and consequences for the zooplankton variability, based on spatial and temporal coherence with environmental and fishery time series.
- Sensitivity and specificity of data-analysis tools.

4. Time frame and expected products

We will begin work in early 2005 and would continue for three to four years. We will convene annual WG meetings (each of about 2- to 3-days duration), and a larger open-attendance symposium in the final or penultimate year. The first meeting is planned for autumn 2005, at the U.S. NMFS facility in Silver Springs, Maryland, USA. An ideal venue for the 2007 session would be the next International Zooplankton Symposium, scheduled for 2007 in Japan. This would also include a collective scientific publication (either a special issue of an international journal, or a book). For each year, expected activities and products include

- *Year 1:* Summarize and evaluate methods, results, and questions arising from the zooplankton time-series analyses that have been completed to date. For the proposed new comparative analyses, select and prioritize the set of regional time series, and the suite of variables from each time series that will be compared (e.g., total zooplankton biomass, major-group and/or species-level zooplankton taxonomic composition, phenology, and physical and biological environmental indices). Identify obstacles to pooled analyses (e.g., incomplete processing, differences in formatting, differences in resolution). Develop recommendations for data exchange, and feasible enhancements of sample processing.
- *Year 2:* Begin comparative analyses. Evaluate sensitivity and specificity of data analysis (statistical) tools, and improve their availability and “user friendliness”. Identify time scales and date intervals of particular interest. Post selected tools and data on a Web or ftp site (initially closed, eventually public?).
- *Year 3:* Complete comparative analyses of zooplankton and environmental time series, incorporating any new data that have become available during years 1-3. Identify synchronies (if any) in timing of fluctuations, and quantify correlation time and space scales. Prepare interpretive paper(s) for symposium presentation and publication. Prepare recommendations for “best practice” sampling and analysis methodologies.

5. Proposed Working Group membership

Our primary goal is broad experience on zooplankton time series, combined with local knowledge of the contents and quality issues for each regional data set. However, we suggest that one member of the core working group should be a statistical specialist and another should strong data management expertise. Our suggested list (#11-15 could be Associate Members funded by other agencies):

1. David Mackas [cochair](Canada, northern California Current & subarctic NE Pacific)
2. Hans Verheye [cochair] (S. Africa, Benguela)
3. Andy Solow (USA, primarily as statistics expert on spatially and temporally autocorrelated time series, but also familiar with NW Atlantic data sets)
4. Sanae Chiba (Japan marginal seas and oceanic NW Pacific, including the Project Odate reanalysis)
5. Mark Ohman (USA, CalCOFI region)
6. Anthony Richardson (UK, CPR, NE Atlantic)
7. Young-Shil Kang (Korea, NE Asian marginal seas)
8. Patricia Ayon (Peru, IMARPE data set plus general Humboldt Current region)

9. Todd O'Brien (USA, in charge of US NMFS global archive of plankton data)
10. Chris Reason (South Africa, ocean climatologist and member of the CLIVAR Atlantic Panel)

Associate Members funded from sources other than SCOR will also be recruited. We are presently working to identify sources of travel funding for the Associate Members.

Table 1. Representative long time series (with ≥ 10 years of consecutive sampling) zooplankton observation programs (summarized from Perry et al., in press)

Program	Start & end years	Location
North Pacific		
CalCOFI	1949 – continuing (quarterly)	California
Station PAPA	1956 – continuing (3 times per year)	North Pacific, 50°N, 145°W
Newport, OR, USA	Intermittent since 1969, continuous since 1996 (5 times per year)	Offshore transect at 44°39.1'N (Oregon)
Vancouver Island Shelf	1985 – continuing (3-5 times per year)	Southwest shelf of Vancouver Island
Odate plankton time series	1951 – continuing (monthly)	Western North Pacific (Kuroshio, Oyashio and transition region east of Japan)
Hokkaido University, Oshoro-Marui time series	1953 – 2001 (annual)	western and central subarctic North Pacific, and Bering Sea (mostly along 180°E)
Japan Meteorological Agency (JMA)	1967, 1972 – continuing (seasonal)	Several transects in western North Pacific (all around Japanese waters)
National Research Institute of Fisheries Science (Japan), fish egg and larvae survey	1971 – continuing (annual)	western subtropical North Pacific (including Kuroshio region)
Hokkaido National Institute of Fisheries, A-Line monitoring	1987 – continuing (5-8 times per year)	western subarctic North Pacific (Oyashio region)
National Fisheries Research and Development Institute (Korea), oceanographic survey	1965 – continuing (6 times per year)	Korean waters
North Atlantic		
Continuous Plankton Recorder (CPR)	1931 – continuing (monthly)	North Atlantic
Helgoland Roads	1974 – continuing (daily to weekly)	Southern North Sea (54.19°N 7.9°E)
Dove Marine Laboratory	1968 – continuing	Central-west North Sea

Stazione Zoologica Anton Dohrn; Station MC	1984 – continuing (weekly to bi-weekly sampling)	Gulf of Naples (40°48.5'N, 14°15'E)
Station 'C', western Mediterranean	1985 – 1995 (weekly)	Gulf of Tigullio, Ligurian Sea, western Mediterranean
Plymouth Marine Lab, Station L4	1988 – continuing (weekly)	Western English Channel
Central Baltic (various agencies)	1976 - continuing (seasonal)	Central Baltic deep basins
Icelandic Monitoring Programme	1961 – continuing (annual)	transects radiating from Iceland
Emerald Basin	1984 – continuing (twice per year)	Scotian Shelf, NW Atlantic
MARMAP and follow up program	1977 - continuing (quarterly)	NE United States continental shelf
Station "2"	1972-1997; 2002 – continuing (weekly)	Lower Narragansett Bay, RI, USA
South Atlantic		
Cape Routine Area monitoring programme, expanded in 1961 to Southern Routine Area monitoring programme	1951 – 1961 (monthly)	Western Cape coast of South Africa (32-34°S; 16°30'-18°15' E)
	1961 – 1967 (monthly)	Southwestern Cape coast of South Africa (32-38° S; 15°30'-22° E)
Pelagic Fish Stock Assessment surveys	1983 – continuing (3 times per year)	Most of South Africa's west and south coasts (28°30' S - 27° E)
Walvis Bay Routine Area monitoring programme	1957 – 1965 (monthly)	Namibian coast, vicinity of Walvis Bay (21-24° S; 12°30'-14°30' E)
SWAPELS Programme	1972 – 1989 (monthly)	Namibian coast (17°30'-27° S; 10°30'-15° E)
South Pacific		
IMARPE zooplankton sampling	1964 – continuing (seasonal)	Peru coast and continental shelf
IFOP zooplankton and ichthyoplankton surveys	Dates to be confirmed	Northern Chilean coast
Southern Ocean		
Elephant Island	1977 – continuing	Elephant Island region of the Antarctic Peninsula

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Annex 4

Proposal for a SCOR Working Group to Investigate the Role of Viruses in Marine Ecosystems

Abstract

Viruses are a crucial component affecting the trophodynamics and composition of marine food webs. While it is clear that viruses are extremely abundant and are responsible for substantial mortality of heterotrophic and autotrophic marine microbes, there is still very limited quantitative information on the mortality imposed by viruses on marine prokaryotic and eukaryotic microbial communities. Data are particularly sparse for historically undersampled environments such as the open and deep oceans (including sediments) as well as the Arctic. Gaining a qualitative and quantitative understanding of the role of viruses in oceanic carbon and nutrient cycling, food web processes and their effect on community diversity is pivotal for assessing the stability of marine food webs and understanding their effects on biogeochemical cycling.

The proposed working group would study the role of viruses in marine ecosystems over a period of four years, culminating in a final report that (1) summarizes past results on virus-mediated mortality of eukaryotic plankton and prokaryotes and its impact on oceanic carbon and nutrient cycling; (2) coordinates data and international collaboration on the role of viruses in different water masses, in particular in the open ocean and deep sea; and (3) assesses the current methodological limitations and develops recommendations for techniques to quantify virus-mediated mortality of microorganisms (eukaryotes and prokaryotes), their impact on carbon and nutrient cycling, and methods for assessing diversity in viral communities. An important aspect of the working group will be to stimulate research to investigate viruses and viral-mediated processes in different water masses, since this promises a better understanding of the effect of viruses on biogeochemical cycles. The working group will also establish and maintain a Web site as a forum that can be used by the “viral community” for exchanging data, ideas and future plans.

Rationale

Understanding the role of viruses in oceanic carbon and nutrient cycling, food web processes and diversity is pivotal for assessing the stability of marine systems and their biogeochemical significance. This understanding is not only of scientific interest; it will also increase the predictability of the effects of global change on biogeochemical processes in the ocean. Moreover, quantitative data on the consequences of viral lysis are necessary to better understand the functioning of marine food webs. This will also facilitate the inclusion of viral effects in oceanic carbon models.

In addition to studying the role of viruses in surface waters, the open ocean and the deep sea, we propose to assess the role of viruses in distinct water masses, that is, “oceanic rivers”, which show a variable degree of mixing. We argue that this approach will increase our understanding of biogeochemical processes, since it takes into account the basic oceanographic reality that the ocean consists of distinct water masses. Up to now, studies on microorganisms that focus on distinct water masses are sparse. A physical description of water masses (temperature, salinity, density) along with the assessment of viral parameters would be a first step to tackle this task.

The best mechanism to focus the scientific community on the role of viruses in marine ecosystems is a working group formed by SCOR. A non-governmental organization such as SCOR is the perfect forum to assemble the scientific expertise from different nations. Moreover, an international working group has the

potential to implement this expertise in developing countries. SCOR is funding fundamental science and attracts top scientists to volunteer their time to participate in its groups. This also increases the chance to attract further funding for the activity of the group. SCOR is the only organization ensuring that the activity is international and involves both established and young scientists as well as scientists from developing countries.

Scientific Background

Marine prokaryotic and eukaryotic microorganisms, that is, eukaryotic phytoplankton, cyanobacteria and heterotrophic prokaryotes (*Bacteria* and *Archaea*), are the main players in the marine carbon cycle. Dominance of autotrophic carbon fixation shifts from eukaryotic phytoplankton to unicellular cyanobacteria in offshore waters and thus the contribution of prokaryotes to primary production is higher in the open ocean than in coastal waters. Viral lysis of photosynthetic organisms results in a reduction of carbon fixation (Suttle et al., 1990). The world's ocean is inhabited by about 1.2×10^{29} prokaryotes producing about 9.3×10^{29} cells per year (Whitman et al., 1998), or in terms of carbon, about 10-20 Gt C y^{-1} . Thus, global oceanic prokaryotic production amounts to about 50% of global oceanic primary production (20-30 Gt C y^{-1}). From this comparison, it becomes clear that the fate of this prokaryotic production is of crucial importance for the oceanic carbon cycle.

About 15 years ago, it was shown that viruses are the most abundant biological entities ("life forms") in the ocean. It is now known that viral lysis is a major mechanism causing mortality of eukaryotic phytoplankton and prokaryotes (reviewed in Fuhrman, 1999 and Wommack and Colwell, 2000). Mortality of cells at all trophic levels due to viral lysis has considerable implications for the flow of energy and matter through the microbial food web. Lysis (disruption of cells) removes production and converts biomass into dissolved organic carbon (DOC) and small particles (Wilhelm and Suttle, 1999), which are available to heterotrophic prokaryotes. This constitutes a short-circuit in the marine food web, the "viral shunt" (Wilhelm and Suttle, 1999), and increases the remineralization of DOC. A model suggests that between 5 and 26% of photosynthetically fixed carbon ends up in the DOC pool due to viral lysis. DOC is the largest pool of organic carbon in the ocean, equaling approximately the carbon present in atmospheric carbon dioxide. Heterotrophic prokaryotes are the only group consuming significant amounts of DOC. Intensive research has been performed on the ecology of oceanic phytoplankton and prokaryotes during the past decades. Thus, it is surprising how little is known about the regulatory mechanisms and the fate of autotrophic and heterotrophic production. This information is urgently needed, since cell death has a major impact on carbon fixation and remineralization and on the composition and reactivity of oceanic DOC (Nagata and Kirchman, 1997), and thus on carbon and nutrient cycling in the ocean. Quantitative studies on the fate of eukaryotic phytoplankton production have rarely considered the potential role of viral infection. There is increasing evidence that viral lysis stimulates the role of prokaryotes as oxidizers of DOC and remineralizers of CO_2 , N, P and Fe. However, little is known about how this affects autotrophic carbon fixation. In addition, the finding that *Archaea* can be as abundant as *Bacteria* in deep marine waters (Karner et al., 2001), has raised considerable interest in the activity and biogeochemical role of this group. Almost nothing is known about viruses infecting pelagic *Archaea* and only a single experimental study suggests that their community composition is affected by viral infection (Winter et al., 2004).

Recent research using a metagenomics (community genomics) approach showed that viral diversity is extremely high (Breitbart et al., 2002) and accumulating evidence shows that viral infection is a driving force for microbial diversification and diversity (Weinbauer and Rassoulzadegan, 2004). Since viral infection is typically species- or even strain-specific and depends on the abundance of host cells, viral

lysis should prevent competitive dominants from taking over and thereby allowing the existence of highly diverse microbial communities. If this “killing the winner” hypothesis (Thingstad, 2000) holds true, viruses should have a major impact on the diversity of cellular organisms and on their biogeochemical role. In order to test this hypothesis, it is necessary to develop (and apply) molecular tools so that we can monitor population dynamics of both viral and host communities simultaneously in the natural marine ecosystem. Viral diversity and activity is tightly linked to host diversity and eukaryote- and prokaryote-mediated ecosystem functioning. However, there is a lack of “hard” data on this influence in most parts of the ocean. While some data have been accumulated for coastal systems, the ocean and deep ocean (including sediments) are largely unexplored territory.

Statement of Work/Terms of Reference

The proposed working group would

1. Summarize past results on virus-mediated mortality of algae and prokaryotes and the impact on oceanic carbon and nutrient cycling.
2. Coordinate data collection to assess the role of viruses in different water masses.
3. Assess the methodological limitations of the techniques available for quantifying the virus-mediated mortality of microorganisms (eukaryotes and prokaryotes) and their impact on carbon and nutrient cycling, and make recommendations for the best available approaches to study viruses and viral processes in the sea.
4. Establish and maintain a Web site as forum that can be used by the “viral community” for exchange of data and ideas and future plans.
5. The SCOR effort will culminate with an International Symposium that could include a published proceeding such as a special issue of *Limnology and Oceanography* or *Deep-Sea Research*.
6. The SCOR effort will also culminate in writing a “definitive” textbook on Methods in Marine Virology.

Tasks 1 and 2 will be accomplished before the first meeting of the WG and data will be made available to the public by a Web site (Task 4).

While reviews on marine viruses are plentiful, there is no standard reference for methods in marine (aquatic) virology. The significance for such an enterprise is illustrated by the problem of preserving samples for counting viruses: several studies failed because samples were not stored properly. Consulting a standard reference book would have avoided this problem. The people involved in the SCOR WG are the ones who know best about methods and problems (Task 3) and they will provide easy to follow “recipes” for various methods and a discussion of the benefits and pitfalls of methods (Task 6). Curtis Suttle has volunteered to edit or co-edit such a book and the chair and co-chair will support him in this editorial task. Willie Wilson and Declan Schroeder have funding for a similar project and are willing to join with the SCOR effort. During the first workshop (Santiago de Compostela 2005), an agreement on topics and authors will be made. During the second workshop (Vancouver 2006), which will be mainly dedicated to this task, a discussion of current methods will be initiated to make sure that single chapters do not only represent the opinion of the author(s). Topics of Discussion and Chapters could include the following: Sampling, Enumeration, Isolation, Identification, Production, Lysogeny, Diversity, Genomics and Metagenomics, and Nucleic Acid Extraction.

Meetings. We propose the first meeting of the Working group (**1st SCOR workshop**) to be held in 2005 in conjunction with the meeting of the American Society of Limnology and Oceanography (ASLO) in

Santiago de Compostela, Spain. At this meeting the final identification of the membership, fine-tuning of the Terms of Reference (such as the topics for the proposed book), and creation of an agenda will take place. A second meeting will be held in association with the workshop (proposed below) in the year following the first meeting. An International Symposium on Viruses in the Ocean will take place approximately three years following the initial meeting in order to allow final discussion, input to the Working group's report, and culminate in a published proceedings.

2nd SCOR Workshop in 2006. An international workshop on oceanic viruses will be convened at the University of British Columbia in Vancouver (Canada) in order to facilitate input to the Working Group for fulfilling the above Terms of Reference. This workshop will be held after the summer ASLO meeting, which is taking place at the relatively closely situated city of Victoria (Canada). This meeting will be held approximately one year after the first meeting, a period necessary to allow for preparing the workshop agenda, issue announcements and invitations, secure needed funds, and make other necessary preparations. This workshop will provide the opportunity to invite additional specialists that can be included in the working group in order to increase the expertise of the Working Group. We will also submit a session to the ASLO meeting (tentative title: Ecological and biogeochemical role of marine viruses – the SCOR working group) to attract the scientific community to our field.

Symposium in 2008. The symposium will be held at the Laboratoire d'Océanographie de Villefranche-sur-mer (France). We will try to get additional money from the French Science Organization (CNRS), from regional governments, from the Federation of European Microbiology Societies (FEMS) and the European Commission. The project would be completed by September 2008.

Working Group membership. Working Group full membership is proposed to consist of ten specialists and will be international in scope. The members listed below have agreed to serve on the Working Group, pending approval and input of SCOR. The members consist of scientists promoting the new field of marine viral ecology at the community level about 15 years ago, scientists from the "second wave" in this field and junior scientists. This mixture has the greatest chance for innovation and developing new perspectives. The chairs will attempt to provide balance and will address coordination, Web site maintenance, dissemination of information and preparation of the final, published report. Two chairs were appointed to make sure these duties will be addressed in an appropriate way by sharing the work load.

Full members

Markus Weinbauer, Chair	France
Steven Wilhelm, Co-chair	USA
Gunnar Bratbak	Norway
Corina Brussaard	Netherlands
Dolores Mehnert	Brazil
Mathias Middelboe	Denmark
Keizo Nagasaki	Japan
Curtis Suttle	Canada
Willie Wilson	UK
Eric Wommack	USA

Associate members

Feng Chen	USA
Roberto Danovaro	Italy
Yoanna Eissler	Chile
Jed Fuhrman	USA
Sonia Ganesella	Brazil
Gerhard Herndl	Netherlands
Nianzhi Jiao	China-Beijing
Nicholas Mann	UK
Telesphore Sime-Ngando	France
John Paul	USA
Declan Schroeder	South Africa
Grieg Steward	USA
Dolors Vaqué	Spain

Most of the (full and associate) members are from North America or Europe. This does not reflect a biased selection of working group members in marine virology, but rather corresponds to the availability of funding (viral research is expensive) and awareness of “hot topics” (viruses are still not often mentioned in textbooks on marine sciences). Viral ecology is only slowly being established in countries with small research budgets. Some working group members have started collaborations with researchers in Chile, Brazil and Kenya. The working group is actively searching for potential contact persons in marine virology in Latin America, Africa and Asia. Scientists in China, India and Nigeria have been identified. These contacts are a first step towards an international marine virology community; the proposed international marine virus workshop in 2008 and the proposed establishment of a Web site (to disseminate data and information on viruses) will be a nucleus for the internationalization of marine virology. Also, we will foster these interactions by trying to attract students from underrepresented countries to join established groups in marine viral ecology. Possibilities for raising funding for collaborations are currently being searched for. Due to inherent problems of predicting the progress of such attempts, it is not possible to present a more precise timetable.

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Annex 5

SCOR Articles of Incorporation

**THE SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH, INC.
a Maryland non-stock corporation****ARTICLES OF INCORPORATION**

FIRST: THE UNDERSIGNED, Craig Berman, whose address is 9515 Deereco Road, Ste. 801, Timonium, Maryland 21093, being at least eighteen years of age, acting as incorporator, does hereby form a non-stock corporation under and by virtue of the General Laws of the State of Maryland.

SECOND: The name of the corporation (which is hereinafter called the “Corporation”) is:

THE SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH, INC.

THIRD: The Corporation is formed to further and promote educational and scientific purposes and the business and objects to be carried on and promoted by it are:

(1) to promote international cooperation for the research of oceanic and marine sciences and to establish international working groups to research and examine oceanic activities, marine studies and other geo-scientific issues; and

(2) to perform other activities permitted corporations under the General Laws of the State of Maryland, to the extent such activities are permitted of organizations which are exempt from Federal income tax under section 501(c)(3) of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law) and contributions to which are deductible under sections 170(c)(2) and 2055(a)(2) of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law), including the making of distributions to organizations that qualify as exempt organizations under Section 501(c)(3) of the Internal Revenue Code of 1986 (or the corresponding provision of any future United States Internal Revenue Law) and also including the making of distributions to states, territories, or possessions of the United States, any political subdivision of any of the foregoing, or to the United States or the District of Columbia, but only for charitable purposes. As used in the previous sentence, “charitable purposes” shall be limited to and shall include only religious, charitable, scientific, literary, or educational purposes within the meaning of those terms as used in Section 501(c)(3) of the Internal Revenue Code of 1986 (or the corresponding provision of any future United States Internal Revenue Law).

FOURTH: The present address of the principal office of the Corporation in the State of Maryland is Department of Earth and Planetary Sciences, Johns Hopkins University, Baltimore, Maryland 21218.

FIFTH: The name and address of the resident agent of the Corporation in this State are Deanna Amos, CPA, 9515 Deereco Road, Ste., 801, Timonium, Maryland 21093. Said resident agent is a citizen of the State of Maryland who resides there.

SIXTH: The Corporation is not authorized to issue capital stock.

SEVENTH: The number of Directors of the Corporation shall be six (6), which number may be increased or decreased pursuant to the Bylaws of the Corporation but shall never be less than the minimum number permitted by the General Laws of the State of Maryland now or hereafter in force. The Directors shall be elected in the manner provided in the Bylaws.

EIGHTH: The following provisions are hereby adopted for defining, adopting, limiting, and regulating the powers of the Corporation and of the Directors and the members.

(1) No part of the net earnings of the Corporation shall inure to the benefit of, or be distributable to, its members, directors, officers, or other private persons, except that the Corporation shall be authorized and empowered to pay reasonable compensation for services rendered and to make payments and distributions in furtherance of the purposes set forth in Article THIRD hereof. No substantial part of the activities of the Corporation shall be the carrying on of propaganda or otherwise attempting to influence legislation, and the Corporation shall not participate in, or intervene in (including the publishing or distribution of statements) any political campaign on behalf of any candidate for public office. Notwithstanding any other provisions of these articles, the Corporation shall not carry on any other activities not permitted to be carried on (a) by a corporation exempt from Federal income tax under section 501(c)(3) of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law) or (b) by a corporation, contributions to which are deductible under sections 170(c)(2) and 2055(a)(2) of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law).

(2) Upon dissolution of the Corporation, the Board of Directors shall, after paying or making provision for the payment of all of the liabilities of the Corporation, dispose of all of the assets of the Corporation exclusively for the purposes of the Corporation (a) to an organization or organizations organized and operated exclusively for charitable, educational, religious, or scientific purposes as shall at the time qualify as an exempt organization or organizations under section 501(c)(3) of the Internal Revenue Code of 1986 (or the corresponding provision of any future United States Internal Revenue Law) contributions to which are deductible under sections 170(c)(2), 2055(a)(2), and 2522(a)(2) of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law), or (b) to states, territories, or possessions of the United States, any political subdivision of any of the foregoing, or to the United States or the District of Columbia, but only for charitable purposes. The Board of Directors shall determine how the Corporation's assets will be distributed in accordance with the foregoing sentence. Any of the Corporation's assets not so disposed of shall be disposed of by the Circuit Court of Baltimore City or such other court sitting in equity in the political sub division in which the principal office of the Corporation is then located, exclusively for such purposes or to such organization or organizations, as said Court shall determine, which are organized and operated exclusively for such purposes.

(3) The Corporation shall indemnify (a) its directors to the full extent permitted by the General Laws of the State of Maryland now or hereafter in force, including the advance of expenses under the procedures provided by such laws; (b) its officers to the same extent it shall indemnify its directors; and (c) its officers who are not directors to such further extent as shall be authorized by the Board of Directors and be consistent with law; provided, however, the foregoing shall not limit the authority of the

Corporation to indemnify other employees and agents consistent with law and that indemnification shall only be to the extent permitted of organizations which are exempt from Federal income tax under section 501(c)(3) of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law) and contributions to which are deductible under sections 170(c)(2), 2055(a)(2), and 2522(a)(2) of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law).

(4) To the fullest extent permitted by Maryland statutory or decisional law, as amended or interpreted, no director or officer of this Corporation shall be personally liable to the Corporation or its members for money damages, provided, however, that the foregoing limitation of director and officer liability shall only be to the extent permitted of organizations which are exempt from federal income tax under Section 501(c)(3) of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law) and contributions to which are deductible under Sections 170(c)(2), 2055(a)(2), and 2522(a)(2) of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law). No amendment of the charter of the Corporation or repeal of any of its provisions shall limit or eliminate the benefits provided to directors and officers under this provision with respect to any act or omission which occurred prior to such amendment or repeal.

(5) During any fiscal year of the Corporation that it is determined to be a private foundation as defined in section 509(a) of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law):

(a) The Corporation shall distribute its income for such taxable year at such time and in such manner as not to become subject to the tax on undistributed income imposed by section 4942 of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law).

(b) The Corporation shall not engage in any act of self-dealing as defined in section 4941(d) of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law).

(c) The Corporation shall not retain any excess business holdings as defined in section 4943(c) of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law).

(d) The Corporation shall not make any investments in such manner as to subject it to tax under section 4944 of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law).

(e) The Corporation shall not make any taxable expenditures as defined in section 4945(d) of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law).

(6) The Corporation retains the right to further amend its corporate purposes so that it may embrace any activity which may properly be engaged in by any organization which is exempt from Federal income tax under section 501(c)(3) of the Internal Revenue Code of 1986 (or the corresponding

provisions of any future United States Internal Revenue Law) and contributions to which are deductible under sections 170(c)(2) and 2055(a)(2) of the Internal Revenue Code of 1986 (or the corresponding provisions of any future United States Internal Revenue Law), and all contributions to the Corporation are made subject to this provision unless otherwise specifically stated in writing at the time of making the contribution.

The enumeration and definition of particular powers of the Board of Directors included in the foregoing shall in no way be limited or restricted by reference to or inference from the terms of any other clause of this or any other Article of the charter of the Corporation, or construed as or deemed by inference or otherwise in any manner to exclude or limit any powers conferred upon the Board of Directors under the General Laws of the State of Maryland now or hereafter in force, except to the extent that the General Laws of the State of Maryland permit activities which are not permitted under Federal Law for any organization which is exempt from Federal income tax under section 501(c)(3) of the Internal Revenue Code of 1986 (or the corresponding provision of any future United States Internal Revenue Law) and contributions to which are deductible under sections 170(c)(2) and 2055(a)(2) of the Internal Revenue Code of 1986 (or the corresponding provisions under any future United States Internal Revenue Law).

NINTH: The duration of the Corporation shall be perpetual.

Annex 6

Report of the SCOR/IOC/IGBP GLOBEC International Programme for 2003/2004 to the SCOR Assembly. Venice, Italy 27-30 September 2004

Manuel Barange, Director GLOBEC International Project Office
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1. RECENT PROGRESS: Symposia and Working Group activities

1.1. GLOBEC-sponsored symposia

- **GLOBEC/PICES/ICES 3rd Zooplankton Symposium. Gijon, Spain, May 2003**

In May 2003 GLOBEC hosted the 3rd *International Zooplankton Symposium- The role of zooplankton in global ecosystems dynamics: comparative studies from the world oceans* in Gijon, Spain. The OSM was attended by approximately 350 scientists from 53 countries. The main goal was to define the current “state of the art” of zooplankton ecology, with a focus on the effect of climate variability and global climate change on zooplankton. Four workshops preceded the conference, and the Proceedings appeared in *ICES J. Mar. Sci.* 61 (Valdes et al., 2004).

- **UK GLOBEC Open Science Meeting, London, February 2004**

This effort was the culmination of the main UK GLOBEC field programme, “Marine Productivity”, which is due to complete its work in March 2005. The meeting received extensive media coverage nationally and internationally (including coverage in *Nature*), and has significantly influenced a re-organisation of future funding for fisheries and ecosystem research in the United Kingdom, currently divided between institutions and government departments.

- **SCOR/IOC Quantitative ecosystem indicators for fisheries management, Paris, April 2004.**

In support of the organisers GLOBEC contributed funds to sponsor speakers and participants to this meeting, in recognition of the symposium’s relevance to GLOBEC objectives.

- **ICES Symposium on The Influence of Climate Change on North Atlantic Fish Stocks, Bergen, May 2004**

GLOBEC was a major sponsor of this symposium, inviting half of the guest speakers. The meeting was grouped into the following topics:

- 1 - The effect of climate variability on growth, maturity, recruitment and mortality
- 2 - The role of zooplankton in climate-fish relations
- 3 - Taking account of climate in the evaluation of the state of fish stocks
- 4 - Managing fish stocks under future climate scenarios and in the face of climatic uncertainty

This symposium is part of the synthesis efforts of the GLOBEC “Cod and Climate Change” regional programme. The proceedings will be published in *ICES J. Mar. Sci.* in 2005.

- **GLOBEC symposium on Climate Variability and Sub-Arctic Marine Ecosystems, Victoria, Canada, May 16-20, 2005**

Part of GLOBEC's integration and synthesis effort will be along regional symposia, which will take the role previously delivered through Open Science Meetings. The main sessions of this symposium are

1. Regional Focus Session (Barents/Norwegian, Iceland/Greenland, Labrador/Gulf of St. Lawrence/Hudson Bay, Bering Sea, Sea of Okhotsk, Oyashio)
2. Physical Forcing & Biological Response in the Water Column
3. Warming Impacts on Trophic Coupling
4. Disciplinary sessions (Physics and Chemistry, Primary Production, Secondary Production, Fish, Shellfish, Seabirds and Mammals)
5. Climate Change and the Structure of Ecosystems: The Potential for Trophic Cascades
6. Recent Changes in Ecosystem Structure or Function
7. Implications of Climate-forced Change for Management and Social Institutions

The symposium will also be used to develop an implementation strategy for the new GLOBEC ESSAS programme (see below). Registration and further details are available through www.globec.org.

- **PML/ NERC/ GLOBEC AMEMR (Advances in marine ecosystem modelling research) Symposium, Plymouth, UK, 27-29 June 2005**

This international symposium is being convened by the Plymouth Marine Laboratory as a forum for presentation and discussion of all aspects of model-based marine ecosystem research, encompassing numerical, conceptual, mathematical and statistical approaches. GLOBEC's Focus 3 WG is planning to further several of their integration and synthesis plans at this symposium, as well broadening GLOBEC's modelling networks.

1.2. Focus 1 working group: Retrospective Analysis and Long-term time series

The most salient developments of this working group in the recent past and future are

- A large workshop on ecosystem comparisons, entitled "Climate Variability and Exploited Marine Ecosystems" will be organised for September 2005. The meeting will commission about 15 background papers to be published as part of a special journal issue.
- A paper by the group on interdecadal-to-multicentennial variability in marine ecosystems was published in the recent *PAGES Newsletter*, to assist in the development of links with the paleoceanographic community.
- The Focus 1/SPACC Workshop on "Long-term dynamics of Small Pelagic Fishes and Zooplankton in Japanese Waters" was conducted in Tokyo, 9-10 Dec 2003 and Misaki, 10-11 Dec 2003, and will result in a special issue of *Oceanography*.
- The next Focus 1 WG will be in Honolulu, USA, 25-27 October 2004, following PICES XIII. The main objectives are
 - to present papers at the CLIVAR special session of PICESXIII,
 - Develop synthesis plans of GLOBEC Retrospective Studies,
 - Work on a joint paper on comparisons of regime shifts in the Humboldt and Kuroshio currents,

- Discuss how to interact with the proposed SCOR Working Group on Global Comparisons of Zooplankton Time Series, and
- Continue preparations for the Ecosystem comparison workshop (see point 3.1 above)

1.3. Focus 2 working group: Process Studies

- The Focus is planning its next meeting in Rhode Island, USA, July 18-20, 2004. The goal of the meeting is to develop synthesis plans for the group, including a review paper or collection of papers. Potential titles include
 - Zooplankton reproduction, growth and mortality rates
 - Zooplankton trophodynamic strategies
 - Role of microzooplankton in food webs
 - Ocean physics and basic biological processes of individual organisms
 - Mesoscale physical-biological interaction
 - Large-scale physical-biological interaction
- Future plans for the group include three possible activities for 2005:
 - A joint meeting of the Focus 2 and Focus 3 working groups with emphasis on LTL models and to discuss the sensitivity of individuals and populations to variations in biological processes.
 - A joint workshop with SPACC on methods to estimate food fields for small pelagic fish.
 - A joint meeting with IMBER to develop the concept of “key processes”.

1.4. Focus 3 working group: Prediction and Modelling

- Last year a subgroup of the Focus 3 working group (joined by members of the JGOFS, PICES and IMBER networks) met twice in the UK to prepare a review paper on basin-scale modeling (*Challenges of modelling ocean basin ecosystems*). The output appeared in *Science* (De Young et al., 2004. *Science* 304:1463-1466). Funding for this activity was primarily from SCOR and IOC, with contributions from GLOBEC, PICES and JGOFS.
- A subgroup of Focus 3 met in Bergen at the ICES Symposium on “The Influence of Climate Change on North Atlantic Fish Stocks”, on May 9-10, 2004, to review progress of F3WG, to consider further developments of the basin-scale modelling discussion and the outline and define the steps in the practical implementation of the GLOBEC modelling “rhomboid”, designed to include fish, zooplankton and primary productivity into a single ecosystem model.
- A PICES CCCC Model TT and GLOBEC Focus 3 WG proposal has received funding for 2005 from the APN an “International Workshop on Climate Interactions and Marine Ecosystems: Effects of Climate on the Structure and Function of Marine Food-Webs and Implications for Marine Fish Production in the North Pacific Ocean and Marginal Seas”.
- Finally, Focus 3 will host a full working group meeting in 2005, in a venue and date yet undecided.

1.5 Focus 4 working group: Feedback from changes in marine ecosystem structure

The main activities of the group over the last year include

- A full Focus 4 working group in Banff, June 2003, following the IGBP Congress;
- A group presentation at the IHDP Open Meeting in Montreal, Canada, October 2003; and
- The co-sponsoring of a session at PICES XII, Seoul, Korea, October 2003.

An important plan for 2005 would be the development of an appraisal paper entitled “What are the impacts of marine ecosystem change on coastal communities, and what are the impacts of human community responses on marine ecosystem change”, as a Focus 4 group effort. Four case studies have been chosen: NW Atlantic (B. Neis), NE Pacific (S. Ebbin; M. McCammon; I. Perry), SE Atlantic (J. Field; R. Sumaila), and SE Pacific (K. Broad).

In the medium term, the group would like to focus its effort in organising a symposium in 2007 on “Natural and human system implications of large-scale changes in marine systems” (working title). In the short term they would like to have their next meeting in Spring 2005, to (a) complete the appraisal paper, (b) advance the organization of the Symposium, and (c) integrate on-going activities.

The final composition of the Focus 4 WG has been approved. There is a two-tier membership structure, tier-one members including: Rosemary Ommer (History, Canada), Ian Perry (Fisheries Oceanography, Canada), Kenneth Broad (Anthropology, USA), Patrick Lehodey (Fisheries Oceanography, New Caledonia), Barbara Neis (Sociology, Canada), John Field (Marine Ecology, South Africa), Ana Parma (Fisheries, Argentina), Renato Quiñones (Marine Ecology, Chile), Svein Jentoft (Socio-economics, Norway), and Jiehua Lu (Demography, China).

2. REGIONAL AND NATIONAL PROGRAMME UPDATES (see Annex 1 for more details)

GLOBEC has currently 4 regional programmes, and has a further two in planning phase.

2.1 ICES-GLOBEC Cod and Climate Change project (CCC)

The activities of the group in recent months and in the future include the following:

- A workshop held to develop the CCC synthesis book (to appear in the IGBP Series in 2005), in New Bedford, USA May 2003
- A WG meeting focused on synthesis of past activities and a revised strategic plan for 2005-2009, New Bedford, USA, May 2003
- A theme session on transport of cod larvae at ICES ASC, Tallinn, Estonia, Sept. 2003
- A WG meeting focused on furthering synthesis plans and in particular planning of synthesis workshops, in Bergen, Norway, May 2004
- The ICES Symposium “The Influence of Climate Change on North Atlantic Fish Stocks”, Bergen, Norway, May 2004, already reported on above.

A major update of the programme has been the revision of the Programme Strategic Plan, originally published in 1998. The revision summarises the work of the group up to 2009, and describes its last phase (2004-2009) underpinned by the following proposed programme of workshops:

2005	Impact of zooplankton on cod abundance and production (in collaboration with the ICES WG on zooplankton ecology)
2006	Influence of climate on tropho-dynamics of cod ecosystems The decline (and recovery) of cod stocks in the N Atlantic
2007	The future of cod in a changing climate
2008	Implications of results from CCC for fisheries management
2009	Synthesis II Workshop

2.2. Small Pelagics And Climate Change (SPACC)

These are the main developments of the programme in the last year:

- A project involving IAI/IRD/CICESE/IMARPE started coring off Peru in May 2004 to develop centennial time series of pelagic fish abundance off Callao and Pisco.
- An article on SPACC's paleoecological work has been published in the *IGBP-PAGES Newsletter* (2004)
- A multi-authored paper (F Koster et al.) reviewing work conducted on "Use of environmental indices in fish stock assessment and management procedures: state of the art in pelagic fish stocks" will be presented at the World Fisheries Congress, Vancouver in May 2004.
- A SPACC workshop, "Characterizing and Comparing the Spawning Habitats of Small Pelagic Fish" held at the Univ. Concepción, Chile, 12-13 January 2004. The workshop was followed by a SPACC meeting on "Small Pelagic Fish Spawning Habitat Dynamics and the Daily Egg Production Method", 14-16 January 2004 and received SCOR travel support.
- A meeting of the SPACC Executive Committee was held in Concepción, Chile, 17-18 January 2004.
- An informal network of modelers sharing the same numerical code (ROMS-AGRIF) and tools and implementing comparable regional configurations in Eastern Boundary Currents has been established, including IDYLE/IRD, LPO, LEGOS, LODYC, UCLA, UCT, M&CM, BCLME, JRC, IPIMAR, IMARPE, INRH, and LPA.

A major activity for 2004 is the planned workshop on the "Economics of Small Pelagics and Climate Change" to be held in Portsmouth, UK, 13-15 September 2004, with support from GLOBEC, NOAA and SCOR. The meeting is organised by R. Hannesson, S. Herrick and M. Barange, and aims at publishing a special journal issue of case studies that would lead this research field in years to come.

In terms of SPACC's contribution to synthesis the Executive Committee of SPACC proposes

- A workshop in 2007 and, thereafter, the publication of a book structured along the major research lines of SPACC.
- An international symposium in 2008 presenting in detail the achievements of SPACC along themes and regions, followed by a publication of the symposium proceedings in an international peer-reviewed journal.

SPACC appreciate SCOR's support to developing country scientists attending the Concepción and Portsmouth meetings in 2004.

2.3 Southern Ocean GLOBEC

Having completed the field programme for the USA part of SO GLOBEC, results are now being prepared for publication. Main achievements from the seasonal cruise programme are

- Observed seasonality between winter- and summer-dominant species of birds and mammals. Affinities between species and water masses have been established.
- Observed mixing and formation of water masses (particularly the autumn to winter transition) using sensors located on seals and penguins.

Major programme developments in recent and coming months include

- A joint Georges Bank, NEP and SO GLOBEC session at the 2004 Ocean Sciences Meeting in Portland, Oregon, USA (“Understanding the Physical and Biological Coupling of Marine Population Dynamics”, chaired by E. Hofmann, P. Wiebe and T. Strubb), which received 155 abstracts, presented in 8 oral and 3 poster sessions.
- The Session on Southern Ocean Marine Ecosystems at the SCAR Open Meeting in Bremen, Germany, July 2004. The session will include 20 oral presentations and 14 posters.
- The imminent publication of the 1st SO-GLOBEC *Deep-Sea Research* special issue, including 22 papers from all the countries participating in the SO GLOBEC effort.
- The forthcoming announcement (Fall 2004) of U.S. NSF Polar Programme for SO GLOBEC synthesis and modeling activities. Funding is expected for 2005.
- A follow-on of the successful SO GLOBEC programme under the GLOBEC and IMBER umbrellas. This new activity is named ICCED – Integrated analysis of Circumpolar Climate interactions and Ecosystem Dynamics in the Southern Ocean. ICCED will
 - Encompass interdisciplinary studies to understand climate interactions in the SO and their implications for ecosystem function and feedbacks to biogeochemical cycles.
 - Be circumpolar, and will include field studies
 - Extend and further develop circulation, ecosystem, and biogeochemical models
 - Stimulate capacity building
 - Focus on the whole ecosystem – including cetaceans
 - Provide an opportunity to obtain circumpolar information on cetacean distribution and abundance
 - Continue the partnership with the IWC

2.4. PICES-GLOBEC Climate Change and Carrying Capacity (CCCC)

Forthcoming activities of the CCCC at PICES XIII (Honolulu, USA, October 2004) include

- A 2-day BASS/REX/MODEL Workshop on “Linkages between open ocean and coastal systems II”;
- A 1-day REX Workshop on “The seasonal cycle of plankton production in continental shelf waters around the Pacific Rim”;
- A 1-day MONITOR/POC Workshop on “North Pacific GOOS: Needs and activities”;
- A 1-day MODEL Workshop to prepare a strategy and products for future NEMURO and NEMURO.FISH training sessions; and
- A 1.5-day CCCC scientific session on “The impacts of large-scale climate change on North Pacific marine ecosystems”.

As CCCC moves towards its conclusion a number of programmatic decisions have been taken:

- To disband the existing BASS and REX Task Teams and merge them into a new Task Team titled CFAME (Climate Forcing and Marine Ecosystem)
- To extend the MONITOR Task Team, currently in CCCC, beyond the duration of the CCCC Program. MONITOR has assumed the primary responsibility for the evaluation (and perhaps future versions) of the North Pacific Ecosystem Status Report (NPESR), as well as providing guidance for present and future monitoring programs in the North Pacific. MONITOR is then expected to become a Technical Committee of PICES.

To pave the way to synthesis PICES CCCC has formed NEXT (Nemuro **EX**perimental Planning Team), with the goal to develop a strategy for accomplishing PICES-CCCC Synthesis. NEXT will be chaired by Hal Batchelder and will include other key participants (Gordon McFarlane, Akihiko Yatsu, Shin-ichi Ito, Bernard Megrey, Thomas Wainwright, Douglas Hay, William Peterson, Yoshiro Watanabe, Yukimasa Ishida).

The key step in this synthesis effort is the International North Pacific PICES/GLOBEC CCCC Symposium (Honolulu, 19-21 April 2006).

2.5. New Regional Programmes: CLIOTOP (CLimate Impacts on Oceanic TOP Predators) and ESSAS (Ecosystem Studies of Sub-Arctic Seas)

With support from NSF (through SCOR) GLOBEC initiated a planning phase for a research activity on the impacts of climate variability and change in marine sub-arctic ecosystems. The goal of ESSAS (Ecosystem Studies of Sub-Arctic Systems) is to compare, quantify, understand, and thereby predict the impact of climate variability on the productivity and sustainability of sub-arctic marine ecosystems. The main field regions are the Bering Sea, Sea of Okhotsk, Oyashio Current, Barents Sea, the Newfoundland-Labrador Shelf and the West Greenland shelf, all of which experience seasonal ice cover. A draft science plan was presented at the recent GLOBEC SSC meeting, independently reviewed, and a revised plan is expected to be approved by the GLOBEC Executive in September 2004. The programme will be launched at the forthcoming GLOBEC symposium planned for 2005 in Victoria, Canada (see point 1 above).

In parallel, GLOBEC has been fostering a new pan-equatorial research activity named CLIOTOP (Climate Impacts on Oceanic Top Predators). This activity will focus on populations of tunas, sharks and other large predators, and the ecosystem that sustains them. A draft science plan was recently evaluated and independently reviewed by the GLOBEC SSC, and a final draft is expected to be approved by the GLOBEC Executive in September 2004.

3. GLOBEC INTEGRATION AND SYNTHESIS

GLOBEC is embarking on an integration and synthesis phase that will lead the programme to its conclusion in December 2009. At the most recent GLOBEC SSC meeting the group initiated the development of a blueprint document to set up the goals, milestones and pathways to this I+S. The following table provides a skeleton for this document, which will evolve over coming months (and will probably be much evolved by the time SCOR meets in Venice)

GLOBEC I+S – What is it all about?

A. What is GLOBEC's Philosophy

- Multi/interdisciplinary international collaboration
- Coupled models as integrative tools
- Multi-scale (time, space, institutional) analysis
- Enhanced understanding of the role of high trophic levels and top-down controls (hierarchical)

B. What constitutes GLOBEC's Body of Knowledge:

1. Ecosystem Structure and Function
 - Regional comparisons (High/Low latitudes., coastal/open)
 - Demonstrate the role of climate variability in effecting marine ecosystem changes
 - Identify the relative role of ecosystem components (plankton, fish, humans) in ecosystem functioning
2. Forcings
 - Determine the space/time modes of variability in natural climate processes. Highlight the mechanisms behind ecosystem teleconnections
 - Recognise the role of humans as forces of change
3. Physical/ Biological/ Human interactions and Feedbacks

C. What Innovative methodologies has GLOBEC developed or contributed to?

1. Sampling and technological advances in support of GLOBEC science
2. Coupled models (trophic, scale, time) to investigate structure, function and variability
3. Retrospective studies (particularly multidecadal to centennial) on past ecosystem states
4. Comparative approach (mostly regional)

D. What Management information transfer does GLOBEC strive for?

1. Policy (providing conceptual understanding of ecosystem function)
2. Managers (providing tools to incorporate climate-driven variability)
3. Communities (enhancing communication on GEC and marine sustainability)

E. What Education/Outreach tools/activities does GLOBEC want to engage in?

1. Curriculum development
2. Web-based approaches
3. Animations (scenarios)
4. Lessons learned

This blueprint to I+S will be developed by identifying workshops, symposia and any other activities needed to implement it. Negotiations are underway with the UK's Natural Environment Research Council to provide seed funding for the I+S phase. It is envisaged that funds from SCOR to GLOBEC will be used for the same purpose, in addition to partially supporting the Scientific Steering Committee's annual meeting.

The following is a preliminary calendar of already identified synthesis symposia:

2004	2005	2006	2007	2008	2009	2010
			FOCUS4 ¹			
CCC ²						
		CCCC ³				
				SPACC ⁴		
	ESSAS ⁵		US GLOBEC ⁸			
						GLOBEC ⁶
			4th ZOOPL. ⁷		SO GLOBEC	

- 1- Natural and Human system implications of large-scale changes in marine systems, TBA
- 2- ICES/GLOBEC The influence of Climate change on North Atlantic fish stocks, Bergen, Norway. May 2004
- 3- PICES/GLOBEC Climate Change and Ecosystem impacts in the North Pacific, Honolulu, USA, 19-21 April 2006
- 4- Synthesis of the Small Pelagic Fish and Climate Change Programme, TBA
- 5- Climate variability and sub-arctic marine ecosystems. Victoria, Canada, 16-20 May 2005
- 6- Final GLOBEC Open Science Meeting, TBA
- 7- PICES/ICES/GLOBEC 5th Zooplankton Production Symposium. Hiroshima, Japan, June 2007
- 8- US GLOBEC Synthesis meeting, TBA

4. OTHER PROGRAMME NEWS

1. EUR-OCEANS Network of Excellence. - This activity was recently approved by the European Commission (ca. €10M) as a Network of Excellence, linking about 75 institutes involved in GLOBEC and IMBER research in Europe. EUR-OCEANS plans to initiate activities in 2005.
2. NSF/EU Transatlantic GLOBEC plans – A NSF-EU co-funding proposal to conduct a workshop focused on basin-scale GLOBEC research in the North Atlantic is being evaluated. The proposal is led by Peter Wiebe, and aims at contributing to GLOBEC's overall synthesis by linking some of the USA, Canada, UK, ICES, and other regional activities.
3. Zooplankton Production Symposium – GLOBEC has accepted a request from the organisers of the 5th Zooplankton Production Symposium to consider becoming co-sponsors of the event with PICES and ICES. The partnership was responsible for staging the 4th Zooplankton symposium in 2003.
4. GLOBEC is working with a UK company to develop an Internet-based educational tool that highlights the role of zooplankton in marine ecosystems. The proposal would build on the educational legacy of GLOBEC, and will be developed in coming months.

5. GLOBEC IPO

Staff and infrastructure support for the GLOBEC IPO is provided by a grant from the Natural Environment Research Council of the UK (NERC) and by the Plymouth Marine Laboratory (PML). NERC's grant expires in March 2005. A proposal to renew the funding for the IPO was submitted in March 2004, and has been through independent evaluation. We are currently (June 2004) waiting for a

response, both regarding its continuation and its level of support. The proposal would ensure that GLOBEC would have an IPO until its completion in December 2009.

5.1. Publications

The GLOBEC publication list can be interactively searched at www.globec.org. Since 2000 the list includes a total of 551 peer-reviewed publications. This is expected to be an underestimate of the total publications of GLOBEC researchers, as they have to be logged in the Web site by the authors (or the IPO) and have to acknowledge their contribution to GLOBEC in the article. The real figure is likely to be at least an order of magnitude higher. The following list includes special issues of GLOBEC:

1. *Barange, M., Nykjaer, L.* (Eds.) 2004. ENVIFISH: Investigating environmental causes of pelagic fisheries variability in the SE Atlantic. *Progr. Oceanogr.*, 59(2/3): 177-337.
2. *Batchelder, H.P., Powell, T.* (Eds.) 2002. Physical and Biological Conditions and Processes in the Northeast Pacific Ocean. *Progr. Oceanogr.* 53 (2/4), 105-411
3. *Beardsley, R.C., P.C. Smith, C.M. Lee* (Eds.) 2003. U.S. GLOBEC: Physical processes on Georges Bank (GLOBEC). *J. Geophys. Res.*, Vol. 108, No. C11
4. *Bograd, S.J., D.A. Checkley, Jr. and W. S. Wooster* (Eds.) 2003. CalCOFI: a half century of physical, chemical, and biological research in the California Current System. *Deep-Sea Research II* 50: 2349-2594.
5. *Coombs, S., Harris R., Perry, I., Alheit, J.* (Eds.). 1998. Proceedings GLOBEC 1st Open Science Meeting. Paris, France. *Fisher. Oceanogr.* 7(3/4), 175-390.
6. *Fogarty M.J., Qianlan, J.* (Eds.) 2002. The US GLOBEC program. *Oceanography* 15(2), 1-89.
7. *Harris R., Barange M., Werner F.E., Tang Q.* (Eds.). 2003. Proceedings GLOBEC 2nd Open Science Meeting. Qingdao, China. *Fisher. Oceanogr.* 12(4/5), 221-522.
8. *Mackas, D.L. and B. de Young* (Eds.) 2001. GLOBEC Canada: Response of marine ecosystems to environmental variability. *Can. J. Fisher. Aquat. Sci.* 58(4): 645-761.
9. *Reid, P.C., J.B.L. Mathews and M.A. Smith* (Eds.) 2003. Achievements of the continuous plankton recorder survey and a vision for its future. *Progr. Oceanogr.* 58: 115-358.
10. *Sugimoto, T.* (Ed.) 2002. Long term variations in the Northwest Pacific Ecosystems. A Korea-Japan GLOBEC Symposium. *Fisher. Oceanogr.* 11 (6), 315-370.
11. *Tande, K.S. and C. Miller* (Eds.) 2000. Population Dynamics of *Calanus* in the North Atlantic: Results from the Trans-Atlantic Study of *Calanus finmarchicus*. *ICES J. Mar. Sci.* 57: 1527-1874.
12. *Valdes, L., R. Harris, T. Ikeda, S. McKinnell and W.T. Peterson* (Eds.) 2004. The role of zooplankton in Global Ecosystem Dynamics: comparative studies from the world oceans. *ICES J. Mar. Sci.* 61(4): 441-738.
13. *Wiebe, P.H., Beardsley, C.* (Eds.) 1996. Physical-biological interactions on Georges Bank and its environs. *Deep-Sea Res. II*, 43 (7-8), 1437-2006.
14. *Wiebe, P.H., Beardsley, R.C., Bucklin, A.C., Mountain, D.G.* (Eds.) 2001. Coupled biological and physical studies of plankton populations: Georges Bank and related North Atlantic regions. *Deep-Sea Res.* 48(1/3): 1-684.
15. *Zavatarelli, M. and N. Pinardi* (Eds.). 2001. First SINAPSI Symposium. *Archivio di Oceanografia e Limnologia* 22.

6. GLOBEC SSC 2004

The membership of the GLOBEC SSC is shown in the table below.

Name	Gender	Country	Function	Term end
Dr Jürgen Alheit	M	Germany	Chair Focus 1, SPACC Exec	(Ex-Officio)
VACANT				
Prof John Field	M	South Africa	SSC	1 st term 2004
Dr Roger Harris	M	UK	SSC Past-Chair, Focus 2	(Ex-Officio)
Prof Eileen Hofmann	F	USA	SSC, SO Chair	(Ex-Officio)
Dr Patrick Lehodey	M	New Caledonia	SSC, Focus 4	2 nd term 2005
VACANT				
Prof Rosemary Ommer	F	Canada	SSC, Focus 4 Co-Chair	2 nd term 2005
Dr Geir Ottersen	M	Norway	SSC, CCC Co-Chair	2 nd term 2005
VACANT	F	Argentina	SSC	1 st term 2004
Dr Ian Perry	M	Canada	Focus 4 Co-Chair	(Ex-Officio)
Dr David Runge	M	USA	SSC	1 st term 2005
Prof Qisheng Tang	M	China	SSC	1 st term 2005
Prof Francisco Werner	M	USA	SSC Chair, Focus 3	1 st term as Chair 2005

Drs T Baumgartner (Mexico) and C Marrase (Spain) have both completed their second term and are thus not eligible for re-appointment. Dr A Parma (Argentina) and Prof J Field (South Africa) both complete their first term in 2004. Prof Field will be nominated for a second term, but Dr Parma will remain linked to GLOBEC through her participation in Focus 4 activities. Three new nominations will be made available to the co-sponsors of GLOBEC in due course.

7. CALENDAR OF ACTIVITIES (May 2004-June 2005)

- 9-10 May 2004: ICES/GLOBEC CCC Working Group Meeting, Bergen, Norway
- 9-10 May 2004: GLOBEC Focus 3 Working Group meeting, Bergen, Norway
- 11-14 May 2004: ICES-GLOBEC Symposium on “The Influence of Climate Change on North Atlantic Fish Stocks”. Bergen, Norway
- 18-20 July 2004: GLOBEC Focus 2 Working Group meeting, Rhode Island, USA
- 26-28 July 2004: SCAR Science Conference: Antarctica and the Southern Ocean in the Global System (including SO GLOBEC session). Bremen, Germany
- 26-28 August 2004 - 2nd GECAFS/GLOBEC/EPCOR planning meeting. Guayaquil, Ecuador
- 9 September 2004: GLOBEC Germany Open Meeting. Warnemuende, Germany.

- 13-15 September 2004: SPACC workshop on the economics of small pelagics and climate change. Portsmouth, UK
- 18-20 September 2004: GLOBEC Executive meeting. Plymouth, UK
- 22-25 September 2004. ICES ASC (incl. GLOBEC sessions). Vigo, Spain.
- 14-24 October 2004. PICES XIII (incl. GLOBEC CCCC sessions). Honolulu, USA.
- 22-26 October 2004: GLOBEC Focus 1 Working Group meeting, Honolulu, USA
- 26-28 October: IGBP IPO Executive Officers meeting. Plymouth, UK
- 27-29 November 2004: Second China-Japan-Korea Joint GLOBEC Symposium. Hangzhou, China
- May 2005. GLOBEC SSC meeting. TBA
- 16-21 May 2005: GLOBEC Ecosystem Studies of Sub-Arctic Seas (ESSAS) symposium Victoria, Canada
- 27-29 June 2005: AMEMR: Advances in Marine Ecosystem Modelling Research Plymouth, UK

Appendix 1. GLOBEC National, Multinational and Regional Programmes (Note: This is constantly evolving)

NATIONAL GLOBEC PROGRAMMES					
Country	Duration	Name-code	Funding	Contact	Nature of Programme
Brazil	1998-2002	DEPROAS	Conselho Nacional de Desenvolvimento Cientifico e Tecnologico	Y. Matsuura	3
Canada	1996-1999	GLOBEC Canada	Natural Sciences and Engineering Research Council Fisheries and Oceans Canada	B. de Young	1
Chile	1997-	FONDAP-Humboldt	Chilean National Commission for Science and Technology	R. Escribano	3
China-Beijing	1997-	China GLOBEC	National Natural Science Foundation of China Ministry of Science and Technology	Q. Tang	1
France	1999-	PNEC	Call for proposals, funded for 1 year. Proposals can be resubmitted each year. Mean duration ~4 years.	F. Carlotti	4

Germany	2000-	GLOBEC Germany	Waiting for funding to be approved by Federal Ministry for Education, Science, Research and Technology plus participating institutions	J. Alheit	1
Italy	2000-	SINAPSI	Ministero dell'Universita' e della Ricerca Scientifica e Tecnologica	M. Zavatarelli	
Japan	1997-	Japan GLOBEC	One project funded by Japanese Government, others seem to be institute/university funded	T. Sugimoto	4
Mexico	1997-	IMECOCAL	Consejo Nacional de Ciencia y Tecnologica IAI	T. Baumgartner	3
Netherlands	1993-	Several	Various loosely affiliated projects, various funding agencies	G. Franz	4
Norway	2002- 2005	ECOBE, CLIMAR, ADAPT	EU funding, Norwegian Research Council, Norwegian Institutes and Institute of Marine Research	W. Melle/ S. Sundby	2
Portugal	1999-	GLOBEC Portugal	Portuguese Foundation for Science and Technology, IPIMAR	M. Santos	4
Spain	2001-	GLOBEC Spain	Ministerio de Ciencia, IEO, CSIC	C. Marrase	4
Turkey	1997-	Black Sea GLOBEC		T. Oguz	3
Ukraine	1997-	Ukraine GLOBEC	INTAS, UK DETR Darwin Initiative + others	V. Zaika	4
UK	2000- 2005	Marine Productivity (largest)	NERC Thematic money – individual projects by proposal	P. Williamson	1
USA	1994-	U.S. GLOBEC	NSF and NOAA – individual projects by submitted proposals	M. Fogarty	1

MULTI-NATIONAL PROGRAMMES

Name-Code	Start Year	Countries	Funding	Contact	Nature of programme
BENEFIT	1997-	South Africa, Namibia, Angola, Norway, Germany	Norwegian and German donor agencies, Governments of Angola, Namibia, South Africa	N. Sweijd	1

LIFECO	2000-2003	Norway, Germany, UK, Denmark	EU FP 5	M. St John	3
TASC	1996-1999	Norway, UK, Denmark, Iceland, Germany, France, ICES	EU MAST	K. Tande	3
ENVIFISH	1999-2001	EU countries, Angola, Namibia, South Africa	EU INCO	L. Nikjaer	3
VIBES	1997-2000	France, South Africa	ORSTOM	P. Freon	3
IDYLE I	2001-	France, South Africa	ORSTOM	P. Freon	3
IDYLE II	2004-	France, South Africa, Namibia, Chile, Peru	IRD (ex-ORSTOM)		
NATFISH	2002-	Norway, Morocco, Mauritania, Senegal, Italy	EU INCO	L. Nikjaer	3
OFCCP	2001-	USA, New Caledonia, Mexico, Australia, France, New Zealand, Japan, IATTC	National funding agencies of participating countries, GEF.	P. Lehodey	3

REGIONAL PROGRAMMES					
Name-Code	Start Year	Countries	Funding	Contact	Nature of programme
SPACC	1993-	Spain, France, Germany, Japan, Chile, Peru, Senegal, Mauritania, Portugal, USA, Mexico, and others	National	D. Checkley, C. Roy	4
ICES-CCC	1993-	ICES countries	National, ICES	K. Drinkwater, G. Ottersen	4
PICES-CCCC		Japan, China, Korea, Russia, Canada, USA	National, PICES	M. Kashiwai, H. Batchelder	4
SO		USA, Australia, UK, Germany, IWC, and others.	National	E. Hofmann	1, 4
CLIOTOP	(2005)	[USA, Australia, France, Spain, New Zealand, Japan and others]	National – Final approval by the GLOBEC SSC expected September 2004		

ESSAS	(2005)	[USA, Canada, Norway, Germany, Denmark, Russia, Japan and others]	National – Final approval by the GLOBEC SSC expected September 2004		
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- 1- Specific GLOBEC call by national funding agencies, for individual scientists to bid against.
- 2- As for (1), but only affiliated to GLOBEC after funding has been allocated
- 3- Single project affiliated to GLOBEC post-funding (often with many PIs)
- 4- Group of relevant, independent projects under national funding, affiliated to GLOBEC as a group

Annex 7

GEOHAB Activities 2003-2004

I Workshop on Real-time Coastal Observing Systems for Ecosystem Dynamics and HABs
This workshop was held in Villefranche sur Mer, France on 11-21 June 2003. The workshop was convened by Marcel Babin (a member of the GEOHAB SSC) and John Cullen. The meeting served to review real-time sensing systems applicable for observation, modeling and prediction of plankton dynamics, including HABs, in coastal waters. The meeting objective coincided with the goal of GEOHAB to improve prediction of HABs through enhanced observation and modeling systems and was therefore endorsed by GEOHAB. The workshop was attended by approximately 90 participants, which included several members of the GEOHAB SSC. The proceedings of this meeting are available at <http://www.HABWATCH.org>.

II Publication of Implementation Plan
The GEOHAB *Implementation Plan* was published in November 2003. This document provides both an introduction and overview of implementation and a summary of implementation actions. A formal invitation to participate is also provided, accompanied by a description of the procedure for application and associated obligations and benefits. GEOHAB will encourage combined experimental, observational, and modeling approaches, using current and innovative technologies in a multidisciplinary approach that is consistent with the multiple scales and oceanographic complexity of HAB phenomena.

For the purposes of implementation, the GEOHAB SSC adopted a three-category system for defining and endorsing GEOHAB research:

Core Research is comparative, interdisciplinary, international, and directly addresses the overall goals of GEOHAB as outlined in the GEOHAB *Science Plan*. Core Research will directly address Programme Element 4 on Comparative Ecosystems and thus will cross-cut the other programme elements. Core Research will involve scientific co-ordination by the SSC and comprises oceanographic field studies conducted in, and application of models to, comparable ecosystems, supported by identification of relevant organisms; and measurements of the physical, chemical, and biological processes that control their population dynamics.

A major objective of Core Research is the integration achieved by the application of coupled biological/chemical/physical models to HAB dynamics in geographically distinct ecosystems sharing common features. Modelling activities within Core Research Projects may include the application of specified models to different ecosystems, testing and validation of different models within given ecosystems, and modification of existing models to fit current, emerging or hypothetical data sets. The extent to which HAB species respond in a similar way in ecosystems with similar characteristics will assist in defining the oceanographic processes that influence their population dynamics and community interactions. Interpreted via models, this comparative approach is ultimately expected to lead to an enhanced capability for HAB prediction.

The GEOHAB *Implementation Plan* specifies the formation of Core Research Projects (CRPs) related to four ecosystem types—upwelling systems, fjords and coastal embayments, eutrophic systems, and stratified systems. These CRPs are to be initiated through small, focused open science meetings (see below).

Targeted Research addresses specific objectives outlined in the GEOHAB *Science Plan*. Targeted Research may be solicited by the SSC as the need arises from Core Research Projects. Targeted research differs from Core Research in scope and scale. Whereas Core Research must be comparative, integrative and multi-faceted, Targeted Research activities may be more tightly focussed and directed to a research issue or element. It is expected that such studies of specific processes and mechanisms will facilitate the wider and larger-scale Core Research studies.

Regional/National Research is coordinated at a regional or national level rather than by the SSC, but may be endorsed by GEOHAB. For endorsement by GEOHAB, Regional/National Research activities must share objectives with GEOHAB in furthering the understanding of the ecological and oceanographic mechanisms underlying HAB population dynamics, but may have other overall objectives.

Included in the *Implementation Plan* are Framework Activities that are not research, but will facilitate the implementation of GEOHAB. They serve to enhance the value of research by ensuring consistency, collaboration, and communication among researchers, and include scientific networking and co-ordination of resources, data management, specification of protocols and quality control, capacity building, interaction with other programmes and projects, and resources and funding.

III Open Science Meeting: HABs in Upwelling Systems

The open science meeting on HABs in Upwelling Systems was hosted at the Instituto Nacional de Investigação Agrária e das Pescas (INIAP-IPIMAR), in Lisbon, Portugal on 17-20 November 2003. The meeting planning committee was co-chaired by Grant Pitcher (South Africa) and Teresa Moita (Portugal), and included Francisco Figueiras (Spain), Raphael Kudela (USA), Trevor Probyn (South Africa), and Vera Trainer (USA).

The CRP – HABs in Upwelling Systems is built on the premise that understanding the ecology and oceanography of HABs in upwelling systems will benefit from a comparative approach, which is the method of choice when controlled experimentation is not practical. To the extent that experimental control in the study of marine ecosystems is problematic, comparison presents a potentially powerful alternative for drawing scientific inferences. Comparisons with respect to HABs will incorporate the grouping of species from upwelling systems. Assessment of the extent to which these HAB species respond in a similar way within these systems will allow the oceanographic processes that influence HAB population dynamics and community interactions to be established. Equally important will be identification of upwelling systems that have dissimilar HAB species or groupings. In addition, understanding the response of harmful algae to perturbations within upwelling systems will assist in prediction, and identification of divergences from predicted responses will also be informative.

The OSM served to identify interested participants and research regions and to bring together the international community to design core research. The meeting provided a general overview of HABs in the designated upwelling systems and meeting participants discussed a wide variety of research topics related to HABs in upwelling systems, which were distilled into 8 high-priority research activities:

1. An ecologically based classification of the different harmful species based on their adaptation to the multiple sub-habitats characteristic of upwelling ecosystems. Included in this classification of HAB species in upwelling systems will be the functional role of morphological, physiological, behavioural and life-history characteristics, at the cellular level.

2. Identification of the seed strategies employed by HAB species within upwelling systems. Establishment of the sites of HAB initiation and characterisation of environmental influences on the life history stages of HAB species in upwelling systems is considered a priority in developing a predictive capability.
3. Determination of the influence of small-scale physical processes on the growth and dispersion of HAB species. Turbulent mixing determines much high-frequency environmental fluctuation and in so doing can control nutrient, irradiance, and phytoplankton patchiness, and is also known to affect plankton growth rates. Varying responses in terms of the succession of species within and among upwelling systems will allow inferences of the properties of the upper water column regulating species succession and the development of HABs.
4. An investigation of the nutritional physiology of target species as related to the natural variation in nutrient signals. Although time-series field measurements of nutrient concentrations can provide valuable insight to nutrient dynamics, provided that trans-boundary fluxes are quantified, direct measurements of regeneration and assimilation rates also need to be performed using isotope tracer methodology. These measurements will serve to provide meaningful input to biogeochemical models that can be employed in a predictive manner when coupled with the primary hydrodynamic forcing typical of upwelling ecosystems.
5. An assessment of genetic predisposition versus environmental conditions in the toxin production of target species in different upwelling systems. Variability in toxin production is likely caused by a combination of genotype and environmental conditions and elucidation of these respective roles in toxigenicity is critical in developing a predictive capability. Differences in the absolute toxicity of a given species in separate upwelling regions may be exploited to allow characterization of genes important in toxin synthesis.
6. Determination of the importance of coastal morphology and bathymetry on the dynamics of HABs in upwelling systems. These influences are responsible for creating alternating patterns of active and passive upwelling circulations along the coast which may serve in creating sites favouring bloom initiation, retention, dispersion, etc. Characterisation of these sites will assist in understanding their role in the dynamics of HABs.
7. Field-based observations incorporating measurements of cross-shelf and along-shore advection and their role in the initiation, transport, accumulation and dispersion of HABs. These observations should be made with reference to both vegetative and resting stages of HAB species.
8. Identification of climate indicators as predictors of HAB events in upwelling systems. Evidence exists to suggest that variations in upwelling intensities and locations, and also ecosystems have occurred in concert with warming of the Earth's climate. Research is required to relate the effects of climate change, and associated variation in the predominant physical and chemical forcing mechanisms, on HAB species and communities that typify coastal upwelling environments.

Our understanding of and ability to predict HABs in upwelling systems over the next 5-10 years will reflect the extent to which the above questions are answered. A report of the Open Science Meeting has been completed and will be published by IOC as a GEOHAB document. An additional outcome of the OSM is a manuscript comparing HABs in the Californian, Iberian and Benguela upwelling systems,

based on our present knowledge. The manuscript will be submitted for publication in the journal *Harmful Algae*.

The GEOHAB Scientific Steering Committee (SSC) will help provide international coordination for the CRP – HABs in Upwelling Systems, through the establishment of a GEOHAB CRP Subcommittee. This Subcommittee will commit to the promotion of comparative research and the involvement of individuals from the Californian, Iberian and Benguela upwelling regions, and from other major upwelling systems. The subcommittee will be responsible for working with scientists involved in the CRP to ensure that they coordinate their research, using the same measurement protocols, sharing data, and contributing to observation and model development. One or two members of the CRP Subcommittee will be members of the international GEOHAB SSC, to ensure a strong linkage between the Subcommittee and the SSC.

IV SCOR – IGBP Activity on Data Management for International Marine Research Projects

A meeting on Data Management for International Marine Research Projects was held at The Foresight Centre, University of Liverpool, United Kingdom, on 8-10 December 2003. The meeting objective was to produce a common strategy for managing and sharing marine data within and among IGBP and SCOR projects. GEOHAB was represented at this meeting by Wolfgang Fennel. A report of this meeting is posted on the Web [<http://www.jhu.edu/SCOR/DataMgmt.htm>] and includes the report of Wolfgang Fennel on data types and management within GEOHAB. A decentralized data management and distribution system with a centralized index is proposed for GEOHAB. The components, centralized under the supervision of an IPO, will include a comprehensive inventory of databases relevant to GEOHAB, as well as meta-data, with links to their locations and contact persons. The GEOHAB SSC will discuss programme data management at its next meeting.

V Open Science Meeting: HABs in Fjords and Coastal Embayments

The Open Science Meeting on Harmful Algal Blooms in Fjords and Coastal Embayments took place in Viña del Mar, Chile on 26-29 April 2004. The meeting planning committee was co-chaired by Allan Cembella (Germany) and Leonardo Guzmán (Chile), and included Jorge Diogene (Spain), Bengt Karlson (Sweden), John Largier, (USA), and Suzanne Roy (Canada). The objectives of this meeting were fourfold: (1) to introduce the GEOHAB approach to Core Research to the international community; (2) to foster the development of national and international links to GEOHAB, specifically to Core Research; (3) to review and assess existing knowledge and future prospects for research on HABs in fjords and coastal embayments, and (4) to initiate the development of an action plan for implementation of the Core Research on fjords and coastal embayments.

The invitation to the OSM was issued to all prospective participants in the emerging international Core Research Project; strong participation from Latin America was particularly noteworthy. More than 60 participants attended at least part of the meeting, which featured 11 plenary presentations, more than 25 posters presented by participants, and extensive and lively discussion and question periods following each theme. To stimulate maximal scientific interaction, all posters were presented orally, several times in rotation.

The programme was opened with short welcome addresses from Chilean dignitaries (including representatives of the Comité Oceanográfico Nacional of Chile), the SCOR Executive Director and the Coordinator of the IOC HAB Programme Communication Centre in Copenhagen. After the conclusion of the plenary key lectures, theme break-out workshop groups were formed to discuss comparative approaches and integration of physical versus biological and chemical factors, and the incorporation of hydrodynamic and ecosystem models into this research framework. A series of recommendations and

considerations emerged from these theme workshop groups, such as the key importance of physical constraints in determining hydrodynamics and species outcomes in fjords and coastal embayments and the significance of benthic-pelagic coupling. The critical importance of water residence time was also noted.

On the day following the closure of the plenary meeting, the co-convenors met with the GEOHAB Chairman, the international Core Research Project Coordinating Committee, and representatives of the GEOHAB SSC to plan the research agenda and to prepare the forthcoming summary report. Specific issues addressed included (1) identification of key processes and mechanisms that must be studied in such ecosystems to define HAB dynamics; (2) determination of key questions and working hypotheses; (3) consideration of opportunities, differences and commonalities to be addressed in studies of coastal embayments; (4) discussion of potential key field study sites where research could be implemented; and (5) possibilities and constraints for national and international funding support for research initiatives. This information will be incorporated into a detailed OSM report to be delivered within the next few months.

At the request of participants, an *ad hoc* decision was made to include short summaries of the poster presentations in the OSM report. Invited speakers who presented key lectures were also invited to prepare a manuscript based upon their presentation, subject to peer review and publication in a special GEOHAB edition of the Elsevier journal *Harmful Algae*. The practical implementation of Core Research Project activities in fjords and coastal embayments is in the advanced planning stage and actual field work is anticipated by early 2005.

VI SCOR Meeting on Coordination of International Marine Projects

Supported by the Sloan Foundation, this meeting is scheduled for 23-24 September 2004 to bring together representatives of the major international ocean research and observation projects and programs to discuss common opportunities, issues and problems. GEOHAB will be represented at the meeting by Grant Pitcher and Henrik Enevoldsen. Discussions on the interactions with GOOS will be of particular importance to GEOHAB. Mechanisms to improve the way in which GEOHAB integrates with GOOS need to be addressed by establishing the measurements required from GOOS by GEOHAB and the potential for data from GEOHAB to enter GOOS data streams.

VII XI International Conference on Harmful Algae

A GEOHAB exhibit for display at the XI International Conference on Harmful Algae will be constructed to promote the strategy, mission and achievements of GEOHAB. The display will incorporate the GEOHAB brochure, *Science Plan*, *Implementation Plan*, the Open Science Meetings reports, *Harmful Algae News* reports, etc.

VIII Open Science Meetings: HABs in Eutrophic and Stratified Systems

The OSM on HABs and Eutrophication will be held on 7-10 March 2005 in Baltimore under the leadership of Patricia Glibert. The OSM on Stratified Systems is also scheduled for 2005 under the leadership of Patrick Gentien. The date and location of this latter meeting have yet to be decided.

IX Next SSC Meeting

The next Scientific Steering Committee meeting will be held on 21-23 November 2004 following the XI International Conference on Harmful Algae in Cape Town, South Africa. The focus of this meeting will be on the Core Research Projects and their implementation and future management, the development of targeted research projects (specifically those related to modelling and observation systems), the

development of standard measurement protocols within GEOHAB and the formulation of a GEOHAB data committee.

X ASLO meeting 2005

A special session on Comparable Ecosystem Studies of Harmful Algal Blooms has been organized for the next ASLO meeting in 2005. The three sub-sessions (1) HABs in Upwelling Systems, (2) HABs in Fjords and Coastal Embayments, and (3) HABs in Eutrophic Systems, correspond to Core Research Projects of GEOHAB. It is intended that this session will serve to demonstrate and promote the comparative approach of GEOHAB.

GEOHAB Finances

Income	2003	2004	2005
Carry-over from previous year		\$1,631	\$14,149
NOAA (through SCOR)			\$24,000
NSF (through SCOR)	\$24,913	\$40,574	\$30,000
SCOR Support for LDC Travel	\$2,621	\$1,675	\$5,000
IFREMER	\$13,200		\$5,000
Registration Fees	\$2,625	\$2,525	\$17,500
IOC	\$15,000	\$18,000	\$20,000
Total Income	\$58,359	\$64,405	\$115,649
Expenses			
Publications	\$8,400	\$5,627	
SCOR Administrative Expenses	\$1,328	\$189	
Advertising		\$545	
Other Meetings	\$1,836		
SSC Meeting		\$11,739	\$25,000
Expenses paid through IOC		\$18,000	
Editorial Committee	\$13,200		
LDC Travel	\$2,621		
HABs in Upwelling Systems	\$29,343	\$363	
HABs in Fjords and Coastal Embayments		\$13,793	
HABs and Stratification			\$35,000
HABs and Eutrophication			\$56,365
Total Expenses	\$56,728	\$50,256	\$116,365
Remaining	\$1,631	\$14,149	(\$716)

Annex 8

SOLAS REPORT TO SCOR 2003/2004

Summary of Activities in 2003/2004

SOLAS Implementation

The publication on the Web of the SOLAS *Science Plan and Implementation Strategy* in December 2003 marked the end of the start-up phase of SOLAS and a move towards the implementation of the *Science Plan*.

The implementation of SOLAS will be led by 3 Implementation Groups (IMPs), each responsible for implementing one of the SOLAS Foci.

Implementation Groups 2 and 3 have already met and are drafting the SOLAS *Implementation Plan*, and IMP 1 will do so in October. These Plans set out the detail of what SOLAS hopes to achieve and will initially be available on the Web. When all 3 are complete, they will be published in hard copy. Many countries have SOLAS activities in the planning stages or already underway. With the establishment of an International Project Office, funded for 5 years by the UK NERC, it can be expected that SOLAS coordination and networking will move forward rapidly over the coming years. However, activities are already underway in many countries. Some highlights are presented below.

- Canada, where the C-SOLAS network was funded in 2001 for 5 years. Fieldwork included an iron-enrichment experiment in the N.E. Pacific during July 2002, and a spring bloom cruise in the N.W. Atlantic in 2003 along with 5 other cruises (178 total days at sea during 2002-2003) and a mooring in each ocean to collect temporal data for coordination with linked ocean-atmosphere models. The July 2002 iron addition expedition to Station Papa (called SERIES: the Subarctic Ecosystem Response to Iron Enrichment Study) involved three ships: the Canadian vessel, *J.P. Tully*, the Mexican vessel, *el Puma*, and the Japanese vessel, *Kaiyo-Maru*. The first SOLAS publication in a high-profile journal (Boyd et al., 2004) resulted from this work.
- United Kingdom. The NERC-directed programme UK SOLAS began in Feb. 2004. It will last for 5 years and has \$20M funding. It is coordinated from the UK SOLAS Project Office, which is co-located with the SOLAS International Project Office at the University of East Anglia, Norwich, UK.
- China (Beijing) has recently obtained approximately \$1M funding for SOLAS work. This will commence shortly. The SOLAS *Science Plan and Implementation Strategy* will be translated into Chinese.
- France has several projects that are endorsed by SOLAS. These are part of the PROOF programme (French acronym for Biogeochemical processes in the Ocean and Fluxes) that represents the major French contribution to SOLAS. One such French project is FLEMENCO₂, which aims to improve estimates of CO₂ fluxes in the Southern Ocean, a historically under-sampled region.
- Japan already has many SOLAS-type activities funded (see below), including the SEEDS I and II iron fertilisation studies. As these come to their conclusion, the national committee will submit a proposal for dedicated SOLAS funding.
- Australia and New Zealand SOLAS conducted the Fe Cycle cruise in February 2003, attempting to close the iron budget using a Lagrangian approach. A dual-tracer (SF₆ and ³He) iron-

enrichment experiment, entitled SAGE (SOLAS-ANZ Dual Tracer Gas Exchange Experiment) in March 2004 produced some interesting high wind speed gas transfer measurements.

- The EU. Several Integrated Projects and other proposals have been submitted as part of the Framework VI 2nd call. In particular, proposals for carbon research in the North Atlantic and on aerosols can be expected to provide strong contributions to SOLAS. The 3rd call also presents some opportunities for SOLAS and the IPO is facilitating consortium building.
- The USA has many funded SOLAS-type projects (approximately 50). A U.S. SOLAS Implementation Plan is being drafted.
- Germany has recently submitted a proposal for major funding for a national SOLAS network.
- Brazil has 4 SOLAS projects that are coordinated by a national committee.
- Norwegian SOLAS has just submitted a proposal titled BioGeoChemClim as a contribution to SOLAS.
- Other countries where SOLAS coordination is beginning are India, South Korea, China (Taipei), Russia, and Chile.

Other Activities

- The first SOLAS Summer School was organised by Corinne Le Quééré and Véronique Garçon in June 2003. 75 students and 24 lecturers attended and we received very positive feedback. We are submitting a proposal to run additional summer schools in 2005 and 2007.
- SOLAS Open Science Conference: SOLAS Science 2004, the first open science conference to present the results of SOLAS, will run on 13-16 October 2004 in Halifax, Nova Scotia, Canada. This conference is being organised by the Canadian SOLAS secretariat and will provide a forum for further community building and networking within the SOLAS field.
- The Task Team on Organic Aerosols (IGAC/SOLAS/iLEAPS) met in Hyytiala, Finland in May 2004. A report from the meeting will be circulated in the autumn.
- The Task Team on Halogens in the Troposphere (SOLAS/IGAC) held its first meeting in May. A full report will be available by the time of the SOLAS Open Science Conference.
- The Atmosphere-Ice Chemical Interactions (AICI) Task Team will start to move forward after the SOLAS and IGAC open science conferences.
- The Ocean-Atmosphere-Sea Ice-Snow (OASIS) project has been endorsed by SOLAS. This has links with the International Study of Arctic Change (international SEARCH) and may be complemented by the work of the CliC Arctic Panel.
- The International Polar Year could provide a platform for OASIS, HitT and many other areas of SOLAS, including an “armada” of pCO₂ measurements, to be implemented.

Capacity Building and Inclusion of LDC scientists

The main capacity-building activity of SOLAS is the biennial SOLAS Summer School. 10 young scientists from developing countries attended the 2003 school, supported by the IOC and SCOR.

The SOLAS IPO is developing the lectures from its first summer school into an online learning tool. Currently, the presentations are available on the summer school Web site, but these will be expanded into an online reference. These will be sent on CD to all those who applied for the summer school, and to anyone else who requests a CD. It will also be available on the Web. The IPO will also provide free hard copies or CDs of the SOLAS *Science Plan and Implementation Strategy* to anyone who requests one.

There is also travel funding (~30k USD) available for young scientists from developing countries to attend SOLAS Science 2004, provided by APN, SCOR and IAI.

Casey Ryan,
July 2004

Annex 9

IMBER: Integrated Marine Biogeochemistry and Ecosystem Research

Report 2003/2004

Submitted by Julie Hall, IMBER Chair
On behalf of the IMBER Scientific Steering Committee

Contents

Development of the IMBER Science Plan and Implementation Strategy
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Development of the IMBER Science Plan and Implementation Strategy (SP/IS)

Since the OCEANS Open Science Conference in Paris, the IMBER Transition Team has produced a draft Science Plan and Implementation Strategy (SP/IS) for the IMBER project. On completion of the first draft of the IMBER SP/IS, comment from the scientific community was invited, with a copy of the IMBER SP/IS posted on the Web on 31 October 2003.

An editorial meeting was held in November 2003 (at Johns Hopkins University, Baltimore, USA) at which the comments on the draft received from the scientific community were discussed and used to revise the draft SP/IS. The resulting completed version of the IMBER SP/IS (Appendix 1) was submitted to IGBP and SCOR on 15 January 2004, for review and approval. Following a joint review of the SP/IS by IGBP and SCOR by a panel of 9 scientists from various disciplines, a summary review was provided by IGBP and SCOR to give guidance for revision of the draft SP/IS. The draft SP/IS was approved by IGBP in principle, subject to revision, at the March IGBP SC meeting, and by SCOR by email.

Formation of SSC

An International IMBER Scientific Steering Committee (SSC) was formed in April/May 2004. The members of the SSC include

Julie Hall	New Zealand	<i>Chair</i>
Dennis Hansell	USA	<i>Vice-Chair</i>
Patrick Monfray	France	<i>Vice-Chair</i>
Ann Bucklin	USA	
Jay Cullen	Canada	
Wilco Hazeleger	The Netherlands	
David Hutchins	USA	
Arne Körtzinger	Germany	
Carina Lange	Chile	

Jack Middelburg	The Netherlands
Coleen Moloney	South Africa
S. Wajih A. Naqvi	India
Raymond Pollard	UK
Hiroaki Saito	Japan
Carol Turley	UK
Jing Zhang	China-Beijing

SSC Meeting

The first IMBER SSC meeting will be held in August 2004 (Plymouth Marine Laboratory, UK). The main aims of the meeting are to:

- Review and revise the IMBER SP/IS
- Identify key national and regional IMBER Programmes and linkages with other research programmes
- Develop a plan for implementing IMBER

International Project Office

Since November 2002, a Research Officer has been employed part time in the Interim International Project Office (IPO) for IMBER based at the National Institute of Water and Atmospheric Research Ltd (NIWA), Hamilton, New Zealand with funding from IGBP, SCOR and NIWA. In August 2004, the Interim IPO (employing one person part-time), moved to the Plymouth Marine Laboratory (PML) in the United Kingdom, funded by PML. There are ongoing discussions with Plymouth Marine Laboratory, the First Institute of Oceanography in Qingdao, China, and in France (CNRS and IRD) about funding for the IMBER International Project Office.

Links with Other Projects

SOLAS—To ensure a close and effective collaboration between the two projects in the area of ocean carbon cycle research, IMBER and SOLAS have agreed to develop a joint implementation plan for carbon research. Development of this document is underway, with a meeting planned for September 2004.

Other Projects—Ongoing discussions to develop collaborative relationships are being undertaken with the GLOBEC, LOICZ, GEOTRACES, DIVERSITAS and PAGES projects.

Development of IMBER Research

Several research initiatives that will contribute to IMBER are already underway or are in the planning phase. These include EUR-OCEANS and ICCED.

EUR-OCEANS—The European Network of Excellence (NoE) EUR-OCEANS project aims to achieve lasting integration of European research organisations on global change and pelagic marine ecosystems, and to develop models for assessing and forecasting the impacts of climate and anthropogenic forcing on food-web dynamics (structure, functioning, diversity and stability) of pelagic ecosystems in the open ocean. The NoE will favour the progressive integration of research programmes and facilities of major research institutes all over Europe (69 member organisations from 25 nations). The long-term goal of the

NoE is to create a multi-site Institute for European Research on Ocean Ecosystems under Anthropogenic and Natural Forcings. The international context is provided by GLOBEC and IMBER.

Eur-OCEANS is organised around a Joint Programme of Activities (JPA). The JPA comprises

- Integrating activities on networking, data, and model integration;
- Jointly executed research organised around four broad modelling tasks (together with observations and experiments), on pelagic ecosystems end-to-end, biogeochemistry, ecosystem approaches to marine resources and within-system integration); and
- Activities to spread excellence, including training of researchers, and spreading excellence to socio-economic users and to the European public (through the Association of Aquariums for EUR-OCEANS public outreach).

ICCED: Integrated analyses of Circumpolar Climate interactions and Ecosystem Dynamics in the Southern Ocean, A Southern Ocean Initiative for the OCEANS Programme

Ad Hoc Planning Group:

Eileen E. Hofmann and Walker Smith, USA

Eugene Murphy, United Kingdom

Ulrich Bathmann, Germany

Steve Nicol and Deborah Thiele, Australia

Evgeny Pakhomov, Canada

During the past decade multidisciplinary national and international studies of Southern Ocean ecosystems were undertaken to understand the processes controlling marine population variability and biogeochemical cycling. These programmes encompassed the whole ecosystem, including environmental structure, and will provide the basis for synthesis and modelling activities and additional focussed studies in the coming years. An emerging result from these studies is the importance of circumpolar climate variability and connections in the regional dynamics of Southern Ocean ecosystems, which implies that climate must be an integral focus of future research programmes developed for this region. The Integrated analyses of Circumpolar Climate interactions and Ecosystem Dynamics in the Southern Ocean (ICCED) initiative proposes a coordinated circumpolar approach to understanding climate interactions in the Southern Ocean and implications for ecosystems and the impacts on biogeochemical cycles. The initiative will be composed of circumpolar remote instrumentation and monitoring, an internationally coordinated circumpolar field effort and enhancement of World Ocean Circulation Experiment (WOCE) transects for ecosystem studies, and focussed process studies in key regions. The initiative will extend existing circulation and biological models and further develop modelling efforts directed at an integrated circumpolar view of the operation of the whole ecosystem. An important objective will be to develop international expertise and capability through focussed training courses, workshops, and personnel exchanges. The ICCED initiative directly addresses the questions put forward as a science focus for IMBER and is related to programmes with a Southern Ocean focus including Climate Variability (CLIVAR), Committee for Conservation of Antarctic Marine Living Resources (CCAMLR), International Marine Global Change Study (IMAGES), Global Ocean Ecosystems Dynamics (GLOBEC) project, Global Ocean Observing System (GOOS), the Scientific Committee on Antarctic Research (SCAR), and the International Whaling Commission (IWC).

The objectives of the ICCED initiative are to

1. develop a circumpolar, interdisciplinary approach which will provide a framework for understanding climate interactions in the Southern Ocean, and its implications for ecosystem functioning and impacts on biogeochemical cycles;
2. implement circumpolar (remote) instrumentation that will include large-scale surveys and monitoring, internationally coordinated field efforts, enhanced CLIVAR transects, and focused process studies in key regions;
3. extend and further develop existing circulation and biological models and facilitate the development of integrated circumpolar coupled biogeochemistry-ecosystem models;
4. stimulate capacity building through focused training courses, workshops, and personal exchange; and
5. collaborate with international programmes and organizations, such as CLIVAR, IMAGES, GLOBEC, GOOS, CCAMLR, IWC, and SCAR.

The ICCED initiative is an international effort. It builds upon the scientific results and experiences from the Southern Ocean Joint Global Ocean Flux Study (JGOFS) program, the Southern Ocean GLOBEC program, the WOCE and CCAMLR efforts, and earlier programs, such as the Biological Investigations of Marine Antarctic Systems and Stocks (BIOMASS). As a result of these programs, the Southern Ocean science community is well poised to undertake a circumpolar effort. It is anticipated that the ICCED initiative will form a partnership with the Southern Ocean initiative that is developing through the EUR-OCEANS effort.

Funding

IGBP and SCOR combined funds for Ocean Futures/ Biogeochemistry and Ocean Ecosystems

<u>Income</u>	2003	2004	2005
SCOR - NSF	\$92,114	\$41,667	\$50,000
SCOR Carry-over from Previous Year		\$4,845	\$19,124
IGBP		\$20,000	\$20,000
IGBP (staff support)	\$4,000		
SCOR	\$100		
ICSU	\$50,000		
Registration Fees	\$38,462		
Total Income	\$184,675	\$66,512	\$89,124
Expenses			
Representation at other meetings		\$3,603	
Open Science Conference in Paris	\$138,388		
TT meeting in Paris	\$25,622		
Side Meeting at JGOFS OSM	\$5,458		
Other SCOR Admin	\$2,103	\$351	
IGBP Congress in Banff	\$5,655		
SP/IS Editorial Meeting	\$8,619	\$5,219	
2004 SSC Meeting		\$25,715	
SSC Executive Committee Meeting		\$12,500	
Total Expenses	\$185,844	\$47,388	\$0
Remaining Balance	-\$1,169	\$19,124	\$89,124

Acknowledgements

I would like to thank Ed Urban, Wendy Broadgate and Claire Hamilton for their excellent support during the development of the IMBER *Science Plan and Implementation Strategy*. Special thanks must also go to IGBP, the National Institute of Water and Atmospheric Research (NIWA), SCOR and Plymouth Marine Laboratory for supporting the Interim IMBER International Project Office.

APPENDIX 1: Executive Summary of the IMBER Science Plan and Implementation Strategy Document

The last decade of internationally coordinated marine research has greatly increased our ability to describe and model the ocean's many biological, chemical and physical processes. We have quantified the global fluxes of the major elements, such as carbon, and we continue to identify the organisms and processes central to the functioning of marine ecosystems. A newly emerging challenge, one dictated by society's needs to understand and prepare for the impacts of global change on the Earth System, is to bridge and merge the knowledge bases of the marine biogeochemical and ecosystem disciplines. In response to this need, the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project is being formed as an activity jointly sponsored by International Geosphere-Biosphere Programme (IGBP) and the Scientific Committee on Oceanic Research (SCOR). The IMBER project goal is:

To understand how interactions between marine biogeochemical cycles and ecosystems respond to and force global change.

To achieve this goal it will be important to understand the mechanisms by which marine biogeochemical cycles control marine life and, in turn, how marine life controls biogeochemical cycles. In this light, IMBER research aims to identify key feedbacks from marine biogeochemical cycles and ecosystems to other components of the Earth System. IMBER will focus on processes within, and interactions between, the euphotic and mesopelagic layers of the ocean, the continental margins, and high-latitude and polar ocean areas. An interdisciplinary approach to this research, bringing together the biological and biogeochemical communities, as well as utilising long-term sustained observations, will be important. Embedding process studies within long-term observatories and surveys is required for assessing the changing ocean. An even greater challenge will be drawing together the natural and social science communities to study some of the key impacts and feedbacks between the marine and human systems.

The challenge to the scientific community is to understand interrelationships between biogeochemical cycles and food web dynamics, quantify and predict responses of the marine system to natural and anthropogenic perturbations, (e.g., changes in temperature, stratification, pH and nutrient loading), and estimate feedbacks from the ocean to the Earth System. Critical to our progress will be consideration of the marine system as a continuum from the inshore continental margins to the open ocean and of food webs from microorganisms to top predators. This approach will require an effort much larger than any single nation can mobilise to answer the broad interdisciplinary questions, which require multiple investigators from a range of disciplines and intercomparisons of data from a wide range of systems. IMBER will collaborate with and build on other projects that provide the physical, chemical, and biological context that will support the focus of IMBER research.

To address the IMBER goal, four scientific themes, each including several issues, have been identified for the IMBER project. The themes of IMBER are broad; however, their context is narrowed by the issues and priority questions identified. The eventual content of IMBER will be focused further as detailed implementation plans are developed for each theme and individual nations fund specific research. Theme 1. Key Processes: What are the key marine biogeochemical cycles, ecosystem processes, and their interactions, that will be impacted by global change?

Issues

- Sources and sinks in marine biogeochemical cycles and how these impact macro- and micronutrient stoichiometry;

- Relationships between biodiversity, structure, function, and stability of marine food webs; and
- Interactions between biogeochemical cycles and the structure, function and dynamics of marine food webs.

Theme 2. Sensitivity to Global Change: How will key marine biogeochemical cycles, ecosystems and their interactions, respond to global change?

Issues

- Impact of climate-induced changes in circulation, ventilation and stratification on marine biogeochemical cycles and ecosystems;
- Response of marine biogeochemical cycles, ecosystems and their interactions, to increasing anthropogenic CO₂ and changing pH; and
- Response of marine biogeochemical cycles, ecosystems, and their interactions, to changes in inputs of macro- and micronutrients.

Theme 3. Interactions with the Earth System: What is the role of the ocean biogeochemistry and ecosystems in regulating climate?

Issues

- Oceanic storage of anthropogenic CO₂;
- The role of hypoxia/anoxia in the oceanic nitrogen cycle; and
- Direct ecosystem feedbacks on ocean physics and climate.

Theme 4. Responses of Society: What are the relationships between marine biogeochemical cycles, ecosystems, and the human system?

Issues

- Human lifestyle effects on the state of the ocean; and
- Mitigative and adaptive policies that could reduce the impact of global change on society.

IMBER will encourage investigations in four key domains of the ocean: the euphotic zone, the mesopelagic layer, the continental margins and high-latitude and polar ocean areas.

IMBER will take advantage of new and innovative approaches to conducting marine research, ranging from new molecular techniques to sustained in situ and remotely sensed observations. The development of sustained observation sites will be an important part of the implementation strategy for IMBER, which will be complemented by targeted field-based process studies, in situ mesocosm studies, and both field and laboratory experiments. A suite of hierarchical models will be developed to investigate hypotheses, analyse and extrapolate data in space and time, and identify crucial gaps to be filled by new observations to reduce uncertainties in our knowledge. Extrapolation to the global scale will require integration of data from basin-wide global surveys. To support the modelling and synthesis efforts, interconnected databases of biological, geochemical and physical variables will be constructed, extended and updated in near real time.

The following outcomes are anticipated over the ten-year life of this project.

- An understanding of key marine biogeochemical and ecosystem processes and their sensitivity to global change;
- An increased understanding of the role of biodiversity and food web structure on the cycling and storage of carbon in the ocean;
- Establishment of new high-technology systems for sustained measurements;
- A hierarchy of integrated models that link the mechanisms of biogeochemical cycles with ecosystem processes and provide predictions of the impacts of global change on the ocean system;
- Internationally shared, publicly available data sets and assimilated data products of ocean biogeochemical and ecosystem state variables;
- Identification of potential adaptive and mitigative policies to address the impacts of global change on the ocean system;
- A new generation of marine scientists from developed and developing countries trained in interdisciplinary research and using a systems approach; and
- Sound scientific knowledge to assist policy makers in making informed decisions.

IMBER will encourage the development of collaborative activities that will draw on the expertise of other projects and programmes to avoid unnecessary duplication and ensure that IMBER takes an interdisciplinary scientific approach. These collaborative associations will involve other IGBP/SCOR marine projects and IGBP integrative projects and programmes such as the World Climate Research Programme (WCRP), the International Human Dimensions Programme (IHDP), global observing programmes such as the Global Ocean Observing System (GOOS). A close collaborative relationship with GLOBEC (Global Ocean Ecosystem Dynamics) will be particularly important to ensure that fully integrated biogeochemistry and ecosystems research is undertaken across the entire food web. After 2009 the IGBP II structure will contain a single marine project.

Annex 10 – Post-Audit Financial Statement for 2003

	2003 Revised Budget (Approved in Moscow)			Actual Income and Expense		
	Disc.*	FT**	Totals	Disc.	FT	Totals
Income						
Membership	295,000		295,000	283,295		283,295
ICSU Grant for Ocean Futures		50,000	50,000		50,000	50,000
IOC Contract to SCOR for GLOBEC		10,000	10,000		10,000	10,000
IOC Contract for new activity (Basin-scale modeling)		15,000	15,000		15,000	15,000
IGBP Contribution to OCEANS OSM		4,000	4,000		4,000	4,000
NSF Grant / Travel Awards		75,000	75,000		74,535	74,535
NSF Grant / Science Activities	39,634	373,341	412,975	47,227	339,347	386,574
NSF Grant / Ocean Carbon Observation Workshop		75,000	75,000		43,990	43,990
NSF Grant / GLOBEC ESSAS		88,500	88,500		86,497	86,497
NOAA Support / GEOHAB		427	427		427	427
NOAA Support / GLOBEC OSM Publication		24,555	24,555		24,555	24,555
NOAA Support / WG 119					271	271
OCEANS Conference Registration fees	100	38,462	38,462	100	38,462	38,562
GEOHAB Open Science Mtg, Registration fees		2,500	2,500		2,625	2,625
Sloan Foundation re WG 118		34,384	34,384		19,806	19,806
Marine Minerals Service (re WG 111)					2,060	2,060
Interest, Misc Income + Gain on Exchange				485		485
Total Income	334,734	791,170	1,125,904	331,107	711,575	1,042,682
Expenses						
Iron in Seawater	1,500		1,500	1,500		1,500
Coastal Models					2,060	2,060
Groundwater	17		17	17		17
Asian Monsoons	17		17	1,329		1,329
Permeable Sediments	400		400	-	-	-
Plankton Surveys	17,000		17,000	17,236		17,236
Sediment Traps & 234 Th Methods	15,000		15,000	12,718		12,718
Technologies for Census (Sloan Funds)		34,384	34,384		19,806	19,806
Quantitative Indicators			-	19	271	289
Phaeocystis	15,000		15,000	17,642		17,642
WG 121 (new)	5,000		5,000	5,243		5,243
Ocean Carbon Sequestration Symposium		27,896	27,896		12,006	12,006
Ocean Carbon Observation Workshop		75,000	75,000		43,880	43,880
SCOR/IOC CO2 panel (costs shared)	1,050		1,050	940	110	1,050
JGOFS		99,626	99,626	4,133	74,355	78,488
GLOBEC		201,681	201,681	974	187,292	188,267
GEOHAB		20,428	20,428		25,885	25,885
SOLAS		64,961	64,961	(1,240)	57,199	55,959
OCEANS (now IMBER)	100	167,194	167,294	1,056	188,570	189,627
Data Management activity		10,000	10,000		10,607	10,607
Basin Scale Modeling meetings	6,000	15,000	21,000		15,000	15,000
Travel Awards		70,000	70,000		74,535	74,535
Representation	13,000		13,000	12,819		12,819
Publications	8,000		8,000	7,401		7,401
Annual Meeting	25,000		25,000	23,690		23,690
Salaries and Benefits	117,716	5,000	122,716	118,289		118,289
Moving Expenses for JGOFS EO	10,000		10,000	-		-
Communications	2,100		2,100	3,064		3,064
Office Equipment	2,299		2,299	2,876		2,876
Audit and Accounting Services	2,500		2,500	7,065		7,065
Legal Services re Incorporation	700		700	680		680
JHU overhead charges	16,481		16,481	15,389		15,389
Bank charges	400		400	337		337
Miscellaneous, office supplies,	4,600		4,600	3,424		3,424
Total Expenses	263,880	791,170	1,055,050	256,602	711,575	968,177
Excess of Income over Expenses	70,854			74,505		
Beginning Accumulated Balance	103,694			103,694		
Ending Accumulated Balance	174,548			178,200		

*Disc. = discretionary funding, **FT = flow-through funding

Annex 11
SCOR-Related Meetings (2003-2004)

2003

January 6, 12-13	OCEANS Transition Team Meeting	Paris, France
January 7-10	Biogeochemistry and Ocean Ecosystems Open Science Conference	Paris, France
January 13-15	International Workshop on Ocean Carbon Observation Activities and Their Relation to Planned Research Projects	Paris, France
February 19-22	GEOHAB Editorial Committee	Copenhagen, Denmark
May 2-3	OCEANS Editorial Team Meeting	Washington, D.C., USA
May 5-8	Third JGOFS Open Science Conference	Washington, D.C., USA
May 30-June 2	SCOR-IOC Project on Extending Ecosystem Models to the Basin Scale	Harlow, U.K.
June 11-21	Workshop on Real-time Coastal Observing Systems for Ecosystem Dynamics and Harmful Algal Blooms	Villefranche, France
June 15-20	Gordon Research Conference on Permeable Sediments (WGs 114/112)	Waterville, Maine, USA
June 18,19,24	GLOBEC SSC Meeting OCEANS TT Meeting	Banff, Canada
June 19,24	SOLAS SSC Meeting	Banff, Canada
June 30-July 11	SOLAS Summer School	Corsica, France
July 5-6	IAPSO/SCOR WG 121 on Ocean Mixing	Sapporo, Japan
September 15-19	SCOR Executive Committee Meeting	Moscow, Russia
September 26	Final JGOFS Executive Committee Meeting	Bergen, Norway
October 21-25	SCOR-IOC Project on Extending Ecosystem Models to the Basin Scale	Harlow, U.K.
October 22	WG 118 on New Technologies for Observing Marine Life	Washington, D.C., USA
November 3-7	WG 116 on Sediment Trap and ²³⁴ Th Methods for Carbon Export Flux Determination	Catalina Island, Calif., USA
November 14-16	WG 115 on Standards for the Survey and Analysis of Plankton	Concepción, Chile
November 17-20	GEOHAB Open Science Meeting on HABs in Upwelling Systems	Lisbon, Portugal
December 1-3	IMBER Editorial Committee	Baltimore, Maryland, USA
December 4-8	WG 120 on Marine Phytoplankton and Global Climate: The <i>Phaeocystis</i> sp. Cluster as a Model	Savannah, Georgia, USA
December 8-10	SCOR/IGBP Meeting on Data Management for Marine Research Projects	Liverpool, UK

2004

January 14-17	IOCCP/PICES Workshop on Ocean Surface pCO ₂ Data Integration and Database Development	Tsukuba, Japan
March 31-April 3	WG 119 Conference on Quantitative Ecosystems Indicators for Fisheries Management	Paris, France
April 16-19	GLOBEC SSC Meeting	Swakopmund, Namibia
April 18-22	IGBP/SCOR Meeting on the Global Iron Cycle	Norwich, U.K.

April 25	WG 123 on Reconstruction of Past Ocean Circulation (PACE)	Villefranche-sur-Mer, France
April 26-30	GEOHAB OSM on HABs in Fjords and Coastal Embayments	Valparaiso, Chile
May 10-12	SCOR/IOC Symposium on “The Ocean in a High-CO ₂ World”	Paris, France
May 31 – June 3	International GEOTRACES Planning Committee	Oxford, UK
June 16-18	SOLAS SSC Meeting	Bergen, Norway
June 21-26	IOC Executive Council	Paris, France
August 9-12	IMBER SSC Meeting	Plymouth, UK
August 19-21	WG 116 on Sediment Trap and ²³⁴ Th Methods for Carbon Export Flux Determination	Woods Hole, Mass., USA
September 10	SCOR/IMAGES WG 124 on Analyzing the Links Between Present Oceanic Processes and Paleo-Records (LINKS)	Biarritz, France
September 12-16	WG 122 on Mechanisms of Sediment Retention in Estuaries	Faro, Portugal
September 23-24	SCOR Marine Projects Coordination Meeting	Mestre, Italy
September 27-30	SCOR General Meeting	Venice, Italy
October 11-14	IAPSO/SCOR Symposium on Ocean Mixing	Victoria, B.C., Canada
October 15	WG 121 on Ocean Mixing	Victoria, B.C., Canada
October 13-16	SOLAS Science 2004	Halifax, N.S., Canada
November 21-23	GEOHAB SSC	Cape Town, South Africa
December 5-6	GEOTRACES Editorial Meeting	Boston, Massachusetts, USA
December 6-7	Ocean Carbon Stakeholders Meeting	Paris, France
December 13-16	IMBER Executive Committee/Editorial Meeting	Miami, Florida, USA