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Editorial: GLOBEC Appoints New Steering Committee Chair

Francisco Werner, University of North Carolina, Chapel Hill, USA (cisco@unc.edu)

GLOBEC is entering its final six years as a Core Program within IGBP. The years leading up to this point have been extremely successful with active national and regional programs in place and GLOBEC's important mission recognized throughout the oceanographic and fisheries scientific community. GLOBEC would not be where it is without Roger Harris' efforts – a combination of a great deal of hard work and perhaps a greater amount of tender care. As such, and on behalf of the community of marine scientists, I would like to thank Roger for his immense contribution to our field of study during his past two terms (1996-2002) as Chairman of the GLOBEC Scientific Steering Committee (SSC).

Past GLOBEC SSC Chairs (left to right): Brian Rothschild and Roger Harris, with Qisheng Tang (local organiser) and Cisco Werner at the 2nd GLOBEC Open Science Meeting in China, Oct 2002.

The coming years in GLOBEC will require attention on several fronts. One of the new opportunities will be to work alongside IGBP's "Ocean Biogeochemistry and Ecosystems Analysis Program". The Program completed a successful Open Science Meeting this past January in Paris. The meeting was marked by collegial and exciting discussions that, with all certainty, will lead to future close collaboration between the two programs as exemplified by the article of Hall *et al.* in IGBP Newsletter of June 2002 (see p.18 for an update).

At the same time, the GLOBEC International Project Office (IPO) and SSC will have an extremely important role to play at the regional and national levels in the next years. As some of the programs enter a synthesis phase and as new programs emerge, the need for co-ordination by GLOBEC at this time is essential. The overall goal of GLOBEC includes the "*… understanding of the structure and functioning of the global ocean ecosystem, and its major subsystems …*" which is an undertaking of such magnitude that no national or regional program can achieve on its own.

New national programs have recently been launched in Germany, Spain, Italy, Mexico, and others will launch soon. New regional programs are in the planning stages for sub-Arctic studies (the Ecosystem Studies of the Sub-Arctic Seas, ESSAS-GLOBEC) and for large pelagics (the Climate Impacts on Oceanic Top Predators, CLIOTOP-GLOBEC). ESSAS hopes to build on existing GLOBEC activities in the North Atlantic and the North Pacific, and formulate comparative studies with Southern

Ocean GLOBEC – a program that is entering a synthesis phase after completing a very successful set of field years. CLIOTOP builds up on the GLOBEC OFCCP programme in the equatorial Pacific (see GLOBEC Newsletter 8.2, p.22-24), and aims at establishing GLOBEC research in open ocean tropical (blue) waters of the equatorial Pacific, Indian and Atlantic Oceans. The focus of this program is tuna, billfish and other large pelagics and would provide a counterpart to the GLOBEC SPACC (Small Pelagics and Climate Change) program.

GLOBEC's four working groups will continue to play an important role in the integration of knowledge gained from national and regional programs (through synthesis) and the establishment of links with ongoing programs such as GAIM, CLIVAR, GODAE and GOOS, that can provide the background basin- or global-scale physical forcing needed (by the regional and national programs) to address observed variations of marine ecosystems.

While three of the working groups are natural sciences-based, the main activity of the fourth working group on "Feedbacks from changes in marine ecosystem structure", will provide the important link between natural science and social sciences. Projects are already underway attempting to relate the results of research in ocean and fisheries sciences to human society and its responses.

These are only a few of the activities GLOBEC will be undertaking in the years to come. GLOBEC, through its SSC, IPO and working groups will need to continue being active in assisting and disseminating the synthesis activities of established national and regional programs as well as promoting the creation of new programs and multi-national activities. It is through the sum of these activities that GLOBEC's greatest challenge will be met, the understanding of the structure and functioning of the global ocean ecosystem.

As incoming Chairman of the SSC, I would like to invite any comments, suggestions and help from the community at large in achieving these goals and ensuring the continued success of GLOBEC. I look forward to working with the SSC, the IPO, its Director Manuel Barange, and with our friends at IGBP, SCOR and IOC, the sponsoring agencies that have continuously and generously provided support to GLOBEC.

New GLOBEC Data Manager

Dawn Ashby started work in the GLOBEC International Project Office on January 6th 2003, as the GLOBEC Data Manager, replacing Hester Willson. She has worked at Plymouth Marine Laboratory since 1993 following an Environmental Science degree. Her first appointment was as the assistant to the manager of the Biogeochemical Ocean Flux Study (BOFS) programme, followed by work as an Information Scientist at the National Marine Biological Library. Her role at the GLOBEC IPO will include maintenance of the GLOBEC website, management of the GLOBEC metadatabases, helping to produce GLOBEC publications such as the GLOBEC International Newsletter and assisting the GLOBEC Executive Officer in managing the programme. You can contact Dawn at d.ashby@pml.ac.uk. Dawn is also the Programme Officer for the Atlantic Meridional Transect (AMT) Consortium programme (www.amt-uk.org).

CONTENTS

New Members of the GLOBEC SSC

Two new members have joined the GLOBEC SSC in 2003, replacing Serge Poulet (France), Steve Nicol (Australia) and Takashige Sugimoto (Japan), who are thanked for their support to GLOBEC during their mandates.

Jeffrey Runge

Jeffrey Runge is Research Professor in the Ocean Process Analysis Laboratory, part of the Institute for the Study of Earth, Oceans, and Space at the University of New Hampshire. He holds a Ph.D. in Oceanography, with a research speciality in zooplankton ecology, from the University of Washington. He was a Killam Postdoctoral Fellow in the Department of Oceanography at Dalhousie University in Nova Scotia, then a research scientist at the Université Laval in Québec, where he studied the coupling between ice algal blooms and pelagic ecosystem productivity in Hudson Bay. Prior to coming to the University of New Hampshire in 2001, he worked for 15 years at the Institut Maurice Lamontagne, Fisheries and Oceans, Canada, where he headed a section studying secondary production and fisheries recruitment processes in the Gulf of St. Lawrence.

Dr. Runge is interested in the links between climate, ocean ecosystem productivity and recruitment into the fisheries. In recent years, he has been involved in both the GLOBEC Canada, for which he was a member of the steering committee, and U.S. GLOBEC programs. His field research has focussed on the measurement and ecosystem role of variability in production of zooplankton in the Gulf of St. Lawrence and on Georges Bank. He is actively involved in the development and application of coupled, 3-dimensional physical-biological models to investigate connections among variation in ocean currents and temperature, zooplankton production, and the growth and survival of fish larvae. He is on the editorial board of *Fisheries Oceanography* and is currently chair of RARGOM (Regional Association for Research on the Gulf of Maine), which fosters scientific research in the Gulf of Maine by facilitating communication and collaboration among members of the region's marine institutions.

Qi-Sheng Tang

Qi-Sheng Tang is currently Professor and Director General of the Yellow Sea Fisheries Research Institute. He was voted as an academician of the Chinese Academy of Engineering in 1999, president of the China Fisheries Society in 2001 and has served as chairman of the Fisheries Science Committee (FIS) of the North Pacific Marine Science Organization (PICES), 1992-1996. His research field includes marine fisheries biology, stock assessment and management, marine ecosystem dynamics, and the sustainable utilization of living marine resources. He has published over 160 research papers and books.

Since 1984, Prof. Tang has focused on the study and development of Large Marine Ecosystems (LMEs) and Global Ocean Ecosystem Dynamics (GLOBEC) programmes in China and worldwide. He has been a member of IOC-IUCN-NOAA Consultative Meeting on LMEs since 1994, a member of PICES-GLOBEC Executive Committee and chairman of IGBP/China Committee/GLOBEC since 1995. He is the chief scientist of the China GLOBEC Project II (Ecosystem Dynamics and Living Resources Utilization of the East China Sea and Yellow Sea). His studies focus on the food web trophodynamics of higher trophic levels and ecological effects of environmental change. Recent publications include *Study on Ecosystem Dynamics in Coastal Ocean I: Key Scientific Questions and Development Strategy and Study on Ecosystem Dynamics in Coastal Ocean II: Processes of the Bohai Sea Ecosystem Dynamics* (see GLOBEC International Newsletter 8.2, p.24).

The WORLD OCEAN DATABASE: Building a global-coverage database of ocean profile and plankton data

Todd O'Brien, U.S. National Oceanographic Data Center (Todd.OBrien@noaa.gov)

The *World Ocean Database* is an integrated database of temperature, salinity, dissolved oxygen, nutrients (e.g. nitrite, nitrate, phosphate, silicate), chlorophyll and plankton data (e.g. tows and bottle samples). The latest version, *World Ocean Database 2001*, contains over seven million ocean stations (6.8 million with temperature, 2.1 million with salinity, 250 thousand with nutrients, 150 thousand with chlorophyll, and 140 thousand with plankton tows) and is available to the scientific community, internationally and without restrictions, in a common documented format with quality control flags and access software.

The *World Ocean Database* is made possible through the data and scientific contributions of international scientists, institutions, projects and data centers, and through its participation in the IOC *Global Oceanographic Data Archeology and Rescue* (GODAR) project, which identifies and/or digitizes historical plankton and ocean profile data for rescue and release to the public. To increase the spatial and temporal coverage of plankton in the *World Ocean Database*, there is an ongoing effort to locate and include more historical and recent zooplankton, phytoplankton, and bacterioplankton data, specifically net and/or bottle samples of species composition, abundance, and/or total biomass.

Plankton investigators and data managers are invited to help this database grow through data contributions and through data leads (e.g. names of persons to contact or specific literature references). The goal of this project is to minimize the contributors submitting effort while maximizing the credit and acknowledgement for that data (the effort in originally collecting the data or in collecting the manuscripts containing these data). The project does this as follows:

- Incoming data are accepted in any format (paper or electronic) and will be digitized if required. In cases where rare books or cruise reports are involved, the project is willing to carefully ship, digitize, and then return the articles in a fast and safe manner.
- After receiving the data, it will be carefully reviewed to ensure that the sampling methods and measured data are fully understood and that they will be correctly represented in the database.
- All available information on the responsible investigators, projects, and/or institutions related to the submitted data is stored within each and every individual record (tow, profile, or sample) within the *World Ocean Database* and within the data accession summary logs.

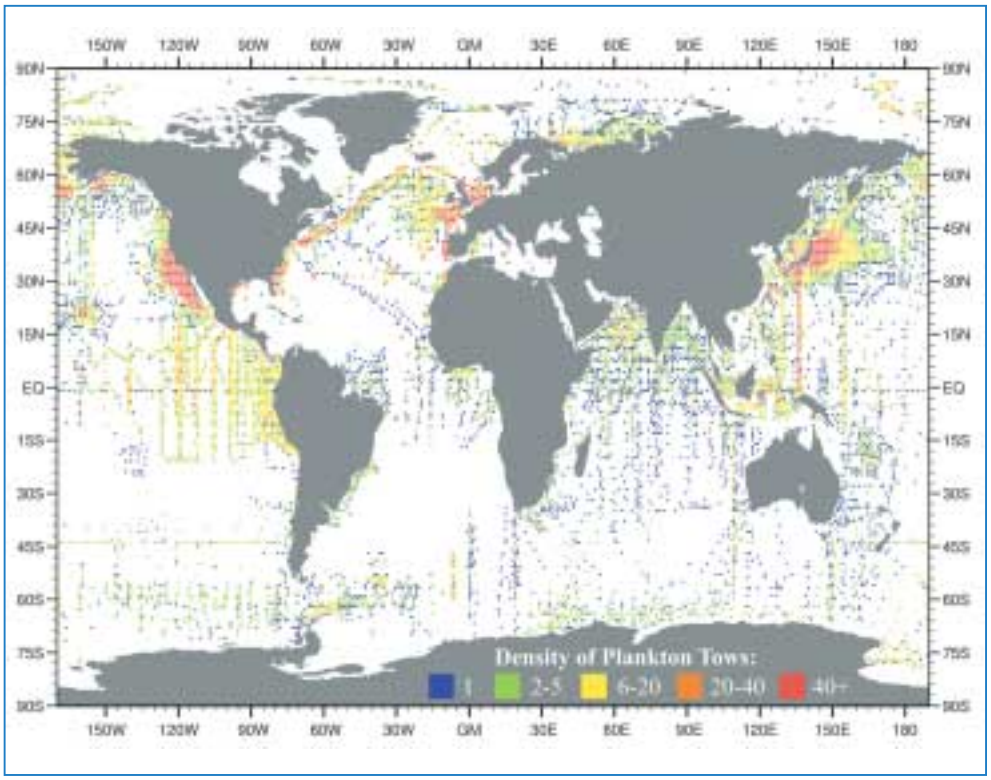


Figure 1. Distribution of plankton tows within the World Ocean Database. Coloured dots indicate the number of plankton tows in each one-degree (latitude-longitude) square containing any data.

Multi-variable integrated databases containing plankton data, such as the *World Ocean Database 2001*, will be useful for a variety of research and modeling applications (e.g., biological/physical interactions, climate change and decadal variability, biogeochemistry and ecosystem dynamics). It is hoped that new contributions and data leads will help improve the plankton content and coverage of this database, and thus improve the quality of such databases available to the scientific community.

Information, data and documentation for the *World Ocean Database* and its plankton content are available at http://www.nodc.noaa.gov/WOD/plankton .

Qualitative and quantitative assessment of zooplankton samples

Gabriel Gorsky & Philippe Grosjean
Observatoire Océanologique, Villefranche sur mer, France (gorsky@obs-vlfr.fr)

Zooplanktonic fauna are the main source of energy from the primary producers to higher trophic levels. Their diversity and abundance can influence the population dynamics of most of the commercial fish species. In order to understand and to model population dynamics of zooplankton and fishes with respect to different environmental parameters a continuous sampling effort by international (cf. GLOBEC, Census of Marine Life-CoML) and national programs is needed. One of the most common sampling methods is the traditional collection of zooplankton with nets. One of the drawbacks of this method is the time required for sample treatment, i.e., identification, measurement and enumeration of individual zooplankton. The process is both time consuming and labor intensive.

The ZOOSCAN is a low-cost imaging system, designed at the Laboratoire Océanographique de Villefranche sur mer, France. This instrument allows a rapid, exhaustive, non-destructive enumeration and measurement of mesozooplankton and micronekton. A given net sample is digitized, the objects are automatically detected, their outlines visualized and labeled (Fig. 1).

Various parameters are extracted from each object using the Matrox Image Library (Matrox MIL). Compressed images are saved for further reference. Results are tabulated and graphed. An automated identification of faunistic groups, using recent classification techniques like neural networks, random forest and classification trees with bagging is under development.

The time required to digitize and analyze images has always been a critical aspect limiting the actual use of automated digital imaging systems for extensive zooplankton analysis. One of the major attributes of the ZOOSCAN is rapid sample processing. Digitization and analysis of a complete sample containing 1500-2000 individuals requires less than 15 minutes. Coincident task processing (identification of the previous sample during the digitization of the following one) will further reduce the duration time of the analysis.

The identification may be improved by combining the identification methods with error detection techniques. Furthermore, a semi-automatic technique is available, allowing for error correction by visual control. The user can visualize an organism in the form of a vignette by clicking on a given data point in a graph and entering the correction (Fig. 2).

The ZOOSCAN provides a means to develop image databanks. The high resolution of the images (8-bits grayscale 2400 dpi; each pixel is about 10 microns wide) allows specialists to identify fauna to genera or species. Non-specialized personnel can use ZOOSCAN for more general categorizations. This method may contribute to the constitution of homogenous datasets from retrospective and future time series analyses. It is conceivable that any interested scientific community could access images and measurements of all the organisms treated with this system through the Internet and undertake investigations in quasi-real time.

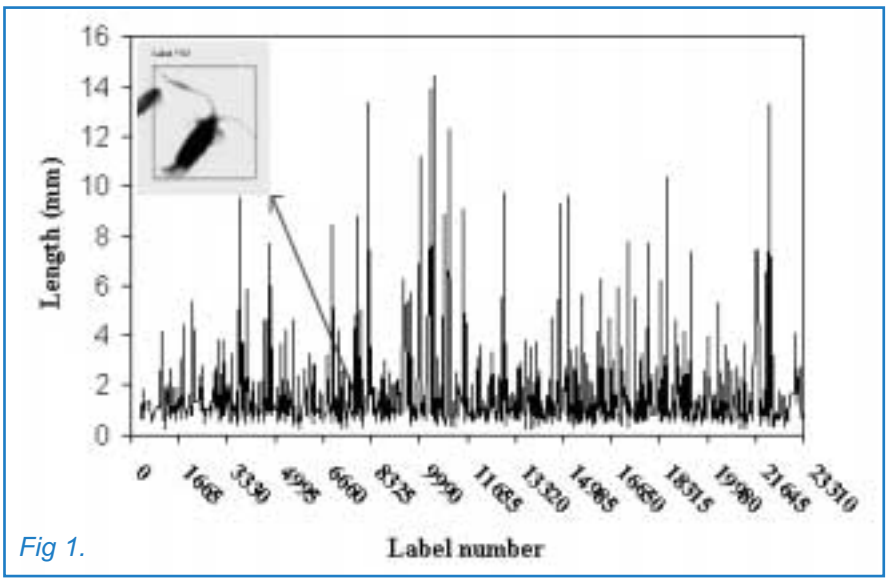


Fig 1.

Figure 1. A plankton tow size distribution and vignette of one organism (a male Centropages typicus) obtained by clicking on a data point in the graph.

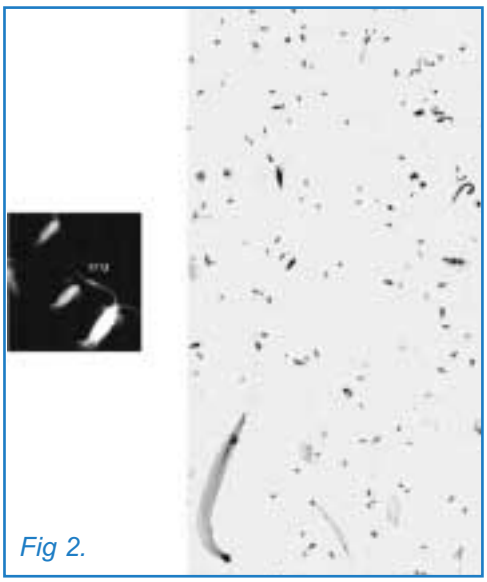


Fig 2.

Figure 2. Fraction of a digitized sample and a zoom on one organism.

News from the Focus II Working Group: Process Studies

Roger Harris, Plymouth Marine Laboratory, Plymouth, UK (rph@pml.ac.uk)

The following members of the Focus 2 Working Group met during the GLOBEC Open Science Meeting in Qingdao, P.R. China, October 13-14 2002: Dian Gifford, Richard Gowen, Roger Harris, Gerhard Kattner, David Mackas, Steve Nicol, Claude Roy, Mike St. John, Atsishi Tsuda, under the Chairmanship of Serge Poulet.

The section on Focus 2 in the GLOBEC Implementation Plan describes Process Studies which outline experimental approaches to investigating specific mechanisms which are thought to link ecosystem responses with environmental variability. The design of these studies should be based on, and closely linked to the retrospective studies under Focus 1, and the modelling and observational work detailed in Focus 3. Close integration is essential. Process studies are also intended to form an integral part of regional and national programmes. It is against this background that the WG began their discussions.

Consequently it was suggested that the activities of the Focus 2 WG should address three main agenda items:

1. define and inter-compare standard approaches and methodologies,
2. define specific tasks to address in the study of the variability of biological rates in relation to physical conditions,
3. organise a meeting to review and compare process studies within the Regional and National Programmes, and to identify gaps between what has been achieved and the goals laid out in the Implementation Plan.

It was suggested that standardisation of approach for new programmes could be achieved by using a common conceptual framework which is outlined in Figure 1. The important point here is that processes studies identify which mechanisms (processes) are most important for connecting physical forcing to key species in specific ecosystems. Furthermore, while there are many processes (arrows in Figure 1) which could be important in specific ecosystems only a few of these processes are likely to impact upon the population dynamics of key species. There is also a need to balance completeness (many arrows quantified), comparability (the same arrows quantified in different programmes) and the number which can be studied well on a given budget. This balance should also be considered in the context of the number of processes which can be incorporated into models.

A number of issues were discussed in relation to standardisation of methodologies: confidence in measurements; calibration (particularly acoustic survey data); sampling (net avoidance); the need to develop and embrace new technologies. Some progress has been made in standardisation of methodologies (JGOFS, protocols) and the ICES Zooplankton Methodology Manual (Harris *et al*., 2000) which includes field and laboratory methods. However, it was agreed that for many methodologies, the potential for implementing GLOBEC-wide standards is limited. This is due in part to regional differences in target organisms (demanding different sampling methods) and in the case of time-series, a desire to maintain established sampling protocols. It was noted that if the protocol for a particular method or sampling technique became too exacting, the cost might be prohibitive for small research programmes. It was concluded that defining standard methods should be given high priority by individual GLOBEC and GLOBEC-like programmes which may be undertaken in the future.

Following discussion of item 2 above, it was decided that this could be achieved by inclusion in the workshop proposed for item 3. Three objectives for this major workshop planned for 2004 were agreed:

- To summarise the key processes identified to impact on the dynamics of key trophic players and ecosystems in GLOBEC and GLOBEC type programs.
- To identify gaps in process related knowledge critical for resolving the effects of global change identified in the aforementioned programs for the inclusion in future research programs.
- Through a comparison of research approaches and implementation strategies identify the strengths and weakness of individual programs for the optimisation of future research initiatives.

It was agreed that members of F2WG would work by correspondence to begin preparation of the proposed workshop. A sub-group of F2WG members would meet at the PICES/ICES/GLOBEC Zooplankton Symposium (May, 2003 Gijón, Spain) to advance planning for the 2004 meeting.

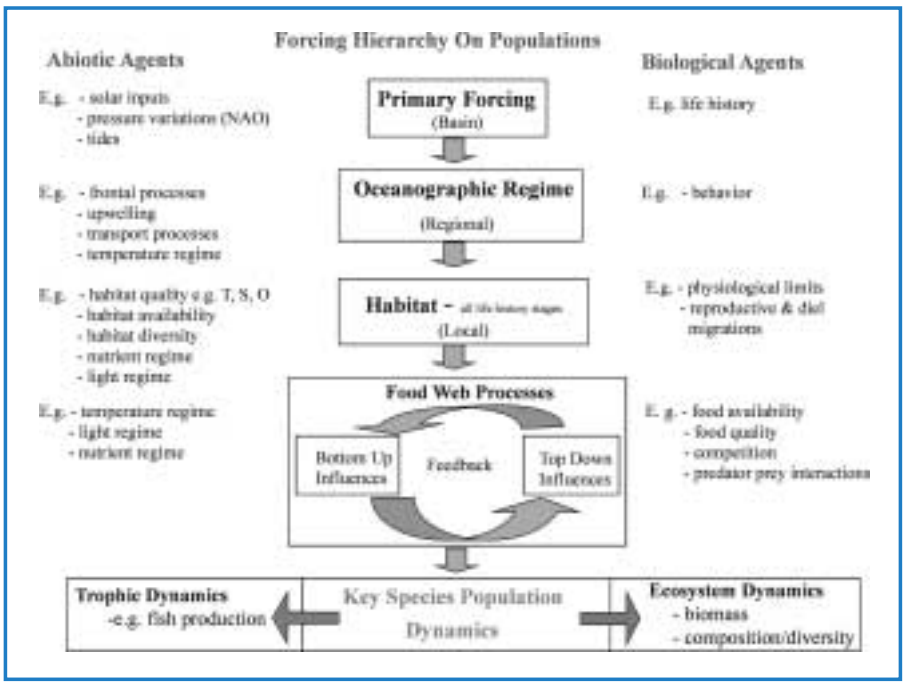


Figure 1. Processes affecting zooplankton

Interaction with Focus 1 and Focus 3 Working Groups

Interaction with Focus Groups 1 (Retrospective Analysis) and 3 (Modelling) was considered a high priority. At a short meeting with F3WG, Serge Poulet itemised three key issues for F2WG:

- a list of key processes impacting on the dynamics of key populations and ecosystems;
- which kind of model frameworks were being discussed by F3;
- the need for a stronger emphasis on species oriented models.

In reply, the chairman of F3WG, Francisco Werner stated that F3WG would propose a series of workshops to explore issues such as the inter-comparison of models. It was agreed that future joint or overlapping meetings of the two Focus Groups or inclusion of some members of F3WG in the proposed F2WG workshop would provide an opportunity for further discussion of shared interests such as model structure and the comparison of results when the same model is applied to different regional systems. This theme was further discussed by a sub-group of F2WG (Uli Bathmann, Claude Roy and Mike St. John) and F3WG (Brad de Young and Francois Carlotti). This group concluded that overlapping F2WG and F3WG workshops would be the best approach. The provisional objectives of the workshops are to:

- identify important biological processes for ecosystem functioning;
- discuss how these key processes are incorporated into global and regional coupled biological physical models.

It was not possible to meet with Focus Group 1. However, in discussion with Jürgen Alheit the chairman of F1WG it was agreed that Mike St. John and Uli Bathmann (F2WG) would meet with Jürgen Alheit to further discuss these topics and plan future interactions between the two Focus Groups. F2WG suggested that topics which could form the basis for future discussions with F1WG might include;

- resolution of ecosystem specific key processes for the potential development of databases,
- development of multivariate proxy time series of key variables and processes,
- identification of new indicators of past and present ecosystem status,
- the identification of proxy indicators of key process for the development of observational or simulated time series of key processes.

Changes in Focus 2 Working Group membership

GLOBEC Working Group members normally serve for a term of three years. Focus Group 2 has been working for 2 years and it was considered appropriate to review membership. The current Chairman announced his intention to stand down and following a brief discussion members of the group decided to recommend Roger Harris as the interim Chairman. It was further agreed that to ensure continuity, only a small proportion of the group should rotate off at any one time. On this basis, Atsishi Tsuda, Gerhard Kattner and Steve Nicol announced their intention to stand down from the Group. The Chairman thanked them for their service. Recommendations for three new members of the Working Group were proposed to the GLOBEC SSC through the Chairman and subsequently Drs Marina Sabatini, Sanae Chiba and Sun Song have accepted invitations to join the group (see box).

The full Focus 2 Working Group Report can be found at www.globec.org

Reference

Harris R.P., P.H. Wiebe, J. Lenz, H.R. Skjoldal and M. Huntley, (editors). 2000. ICES Zooplankton Methodology Manual. 684p. Academic Press.

New members of the Focus 2 Working Group

Marina Sabatini

Instituto Nacional de Investigación, y Desarrollo Pesquero (INIDEP), Mar del Plata, Argentina

My research interests focus on the composition and production of planktonic communities in shelf areas, with special emphasis on copepods. I am currently undertaking plankton research in a frontal area off northern Patagonia (ca. 42° and 45°S) and in southern shelf waters between ca. 47° and 55°S (SW Atlantic). The ultimate purpose of this research is to establish the relative importance of the dominant zooplankton species on fisheries production.

Sanae Chiba

Ecosystem Change Research Program, Frontier Research System for Global Change, Yokohama, Japan

My current research topic is on long-term (up to multi-decadal) variability of lower trophic level ecosystem. I have been conducting a retrospective analysis using climate/hydrographic/biological observational data sets collected in the western North Pacific, with special interests on processes how climatic variability could change upper water environment, and subsequently affect biological productivity.

Sun Song

Institute of Oceanology, Chinese Academy of Sciences, Qingdao, China

One of the key members of the Chinese GLOBEC research program, I am researching on the population dynamics of the key species of zooplankton in the Yellow Sea and East China Sea. Research interests focus on copepod population dynamics and Antarctic krill *Euphausia superba* ecology.

Focus 3 Working Group: Modelling and Predictive Capabilities – meets in Qingdao, October 2002

Brad de Young, Memorial University, Newfoundland, Canada (bdeyoung@physics.mun.ca)

The meeting in Qingdao provided the opportunity for the F3WG to meet with the other GLOBEC working groups and with the modelling task team of PICES. Dr. Bern Megrey attended our meeting as an active member and provided a PICES perspective and also stimulated greater attention to Pacific Basin issues. Our meetings with the PICES modelling task team, and with the other two GLOBEC working groups, have led to contacts and suggestions for further collaboration that the F3WG will follow up on over the next few years.

Now that we are a few years old, just out of our infancy, it seemed appropriate for the F3WG to review its mandate, its progress to date and the opportunities for new initiatives. The working group would like to focus future effort on workshops and meetings that produce concrete results, in particular publications in the open literature. While meeting reports are useful, and reporting to the GLOBEC SSC quite necessary, future activities should be more focused on influencing the broader scientific community. We focused our discussion on a limited number of initiatives in the coming two years.

Development of basin scale ecosystem models

Ideas for the development of basin-scale ecosystem models have been percolating in the community for several years. One initiative of the GAIM (Global Analysis Integration and Modelling) group (www.bgcjena.mpg.de/bgc_prentice/projects/green_ocean/index.html) has also been supported by some informal meetings organized by the F3WG. These discussions are also connected to planning for a North Atlantic study (with a meeting proposed this fall in Iceland – P. Wiebe) and an earlier meeting on the Northwest Atlantic Ecosystem (NORWATE) held in Halifax in June 2001 (Head *et al*., 2001). The developing 'OCEANS' initiative within IGBP also makes discussion of basin-scale ecosystem integration very timely.

It was agreed that we will organize a meeting in 2003 to work on a paper, or publication, that will summarize our ideas and review present progress towards the development of basin scale GLOBEC-type models. The goal would be to define directions needed for the development of models that include population structure and dynamics and couple such models with basin-scale circulation models. Testing in simplified scenarios could be used to explore dependence on gross parameters. While zooplankton are the primary focus within GLOBEC for model development, we recognize the importance of coupling to higher and lower trophic levels. Some of the review will, of necessity, build upon earlier discussion within the F3WG on species focus and fidelity. The three basins that are of immediate interest, simply because of the scientific progress to date, are the Pacific (cf. PICES MODEL Task Team), Atlantic (cf. TASC and UK GLOBEC) and Southern Oceans (cf. Southern Ocean GLOBEC). Including some aspect of equatorial studies would also be desirable. Key species may differ between these basins as will the connections to higher and lower trophic levels. B. deYoung, M. Kishi and E. Murphy will lead this project.

Biological models for the study of individuals, populations and ecosystems

We discussed the development of modelling approaches and identified the development of more generic approaches to modelling marine ecosystems as a priority. We noted the development of models of intermediate complexity and considered that such approaches would be useful particularly when considering the linkage between the lower and higher trophic level systems. Key questions should provide the focus for generic modelling, e.g. can we predict the different species of zooplankton present in different regions?

It was agreed that the many different approaches to zooplankton modelling should be considered together to help identify a more focused sub-set of approaches that the WG could highlight as a useful basis for developing a more generic approach and allowing intercomparisons between different approaches. There are many different models in use within the GLOBEC community and many more are in development. While we do not intend to categorize all the models, we are interested in comparing the different approaches taken to modelling key biological processes and how they are applied within different regional programs. It is intended to hold a workshop at which we will compare the modelling approaches and run code for specific processes to determine the relative strengths and weaknesses of different approaches. While this is primarily a modelling exercise, we are modelling biological processes and it will therefore be important to include scientists working on such processes. It will therefore be important to coordinate our plans with the F2WG. Some of the ideas considered so far include

- Functional responses, such as ingestion response
- Predator-prey relationships
- Diapause (although there may be too little certainty in the conceptual models)
- Mortality – predation, starvation and food condition
- Stage dependent parameterization – just how many stages are parameterized in the same way
- Moving from individuals, to populations and communities
- Coupling to higher and lower trophic levels

Many of the ideas discussed build upon earlier discussions of the F3WG and will also build upon the

basin-scale modelling exercise. The workshop will require substantial planning and preparation and probably funding. We envisage a workshop of 20-30 people held at an appropriate venue where meeting and computer facilities are available. Several possible sources of funding were mentioned (NCEAS, PIMS, JAMSTEC). We will need to explore the options. The workshop will probably be in the spring of 2004 meaning that we might need to apply for funds as early as the spring of 2003. Planning for the workshop will need to take place over the winter of 2002-2003. We will collaborate and communicate with the F2WG to bring together these two working groups for this particular problem. F. Carlotti, B. deYoung, and E. Murphy will lead this effort with support from other members of the WG and in collaboration with F2WG members (M. St. John and C. Roy). It is proposed to meet in 2004.

Other issues

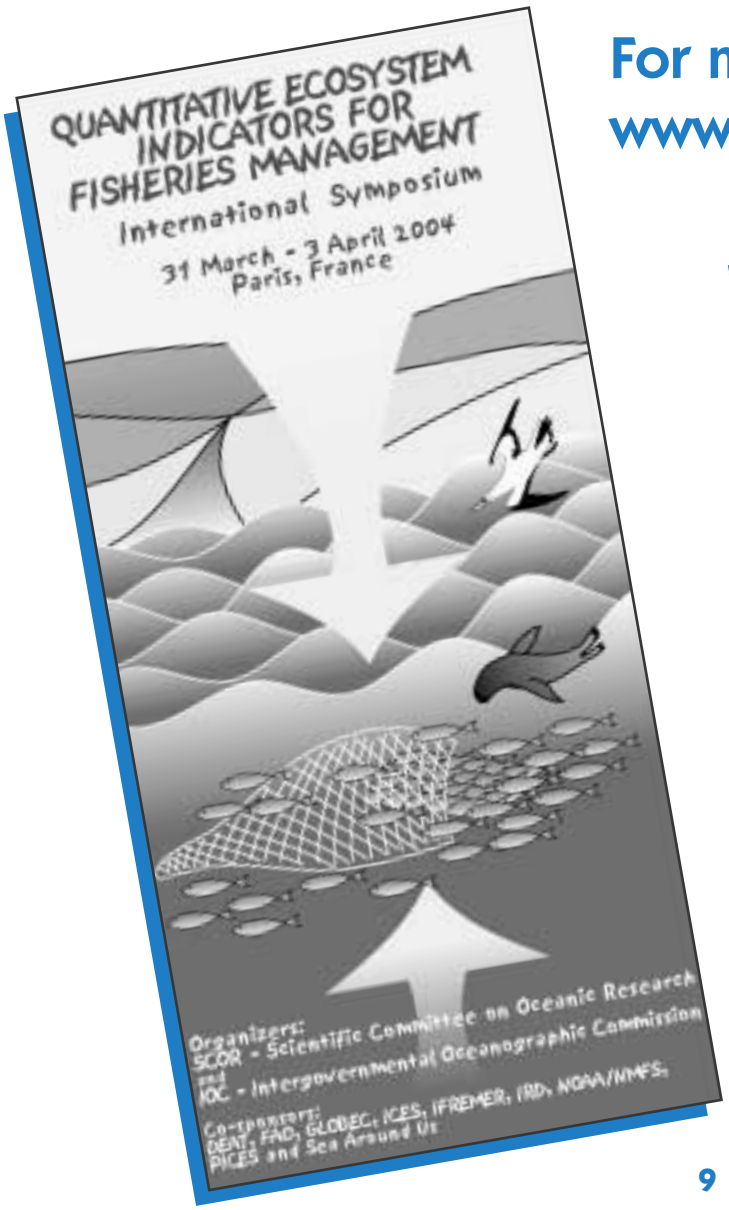
The working group will also explore and develop other activities, either for future implementation or for future development:

- Contact global climate modelling groups (OCMIP2+) to explore opportunities for activity.
- Explore possible venues and topics for capacity building workshops. In particular, we will ask those that might be interested what workshops would be of interest.
- Different members of the F3WG will make contacts with other modelling working groups (e.g. PICES, ICES, GAIM, JGOFS) to enhance communication on modelling activities and explore opportunities for collaborative actions.

Anyone with an interest in our initiatives is encouraged to contact one of the co-chairs – Brad deYoung (bdeyoung@physics.mun.ca) or Michio Kishi (kishi@salmon.fish.hokudai.ac.jp).

Reference

Head E., P. Pepin, J. Runge. 2001. Proceedings of the workshop on the Northwest Atlantic Ecosystem: a basin scale approach. World Trade and Convention Centre, Halifax, Nova Scotia, Canada, 21-23 June 2001. Canadian Science Advisory Secretariat Proceedings Series: 2001/23. Ottawa: Canadian Science Advisory Secretariat, 113p.



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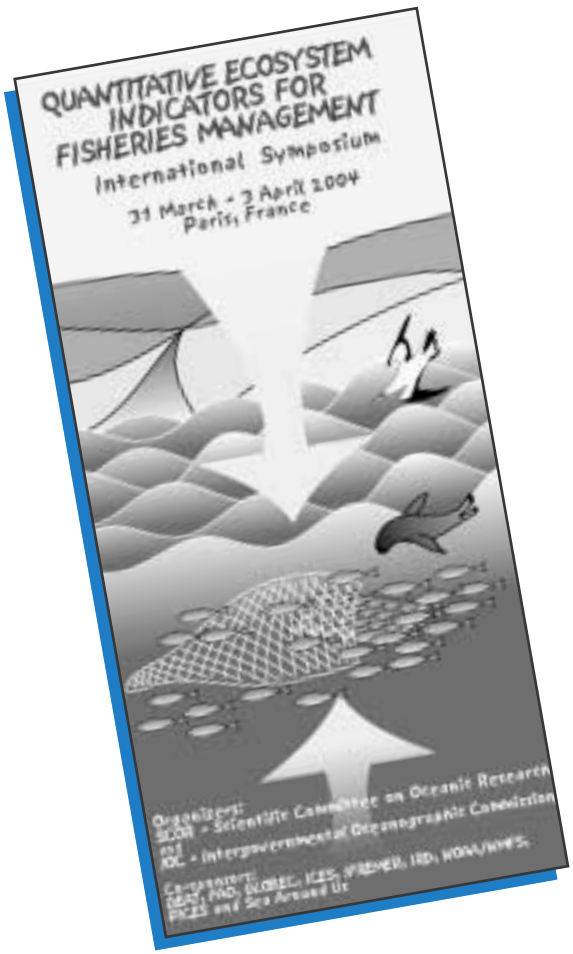


SAHFOS PAGE

Increased incidence of winter phytoplankton blooms in the northwest Atlantic

David Johns (djoh@mail.pml.ac.uk), Martin Edwards (maed@mail.pml.ac.uk) and Anthony Richardson (anr@mail.pml.ac.uk), SAHFOS, Plymouth, UK.

Sampling by the Continuous Plankton Recorder (CPR) over the northwest Atlantic from 1960-2000 has enabled long term studies of the phytoplankton community, highlighting various changes. Due to a break in sampling during the 1980s, two periods were used for analyses, 1962-1978 and 1991-2000. Analysis of an index of phytoplankton biomass, Phytoplankton Colour, revealed an increase over the past decade, most marked during the winter months (December – February). To further investigate this change, the winter phytoplankton community structure was examined using multiple linear regression models. Results indicated that the winter phytoplankton community composition changed markedly in the period 1991-2000, compared to the 1962-1978 period. In the first period there were 14 contributing phytoplankton taxa to the Phytoplankton Colour, but this had dropped to 9 taxa in the latter period.

Looking at the community in more detail, one species, the dinoflagellate *Ceratium arcticum* (Cleve), can be highlighted: it has undergone dramatic changes in abundance during the 1991-2000 period, with pronounced large winter blooms and decreased autumnal levels (Fig. 1). It was also significantly correlated with the Phytoplankton Colour index (r^2=0.78, p<0.01, n=9) in this period, but not in the earlier period. Other dominant species in the phytoplankton community, both diatoms and dinoflagellates, did not show the same variations over the examined time periods. For example, the most frequently recorded phytoplankton taxon, *Thalassiosira* spp., increased in abundance over the examined time period, although its contribution to winter Phytoplankton Colour index values dropped in the 1990s. It is suggested that the response of *C. arcticum* is probably a result of previously reported changes in stratification in the northwest Atlantic, due to dynamic hydro-climatic (freshening and cooling) events, and these have an effect on large-scale processes such as the Labrador Current. Changes in the intensity of the Labrador Current have altered the annual structure of stratification. Work by Jo Craig *et al.* (Department of Fisheries and Oceans, Canada) indicates a change in stratification on the inner Newfoundland Shelf, with an index increasing significantly over the past decade. This is because surface waters throughout the 1990s have been fresher in the study area, creating more-persistent stratification. It is likely that this haline stratification plays an important part in *C. arcticum* abundance through a delay in the breakdown or initiation of an earlier stratified layer, although the exact mechanisms are not known. The massive abundance of *C. arcticum* in 1996, where it contributed almost 47% of the total recorded phytoplankton community, corresponded to the freshest Labrador seawater event on record.

The ability to identify long-term changes in the phytoplankton community highlights the important role the Continuous Plankton Recorder survey plays in monitoring macro-scale ecosystems and global change.

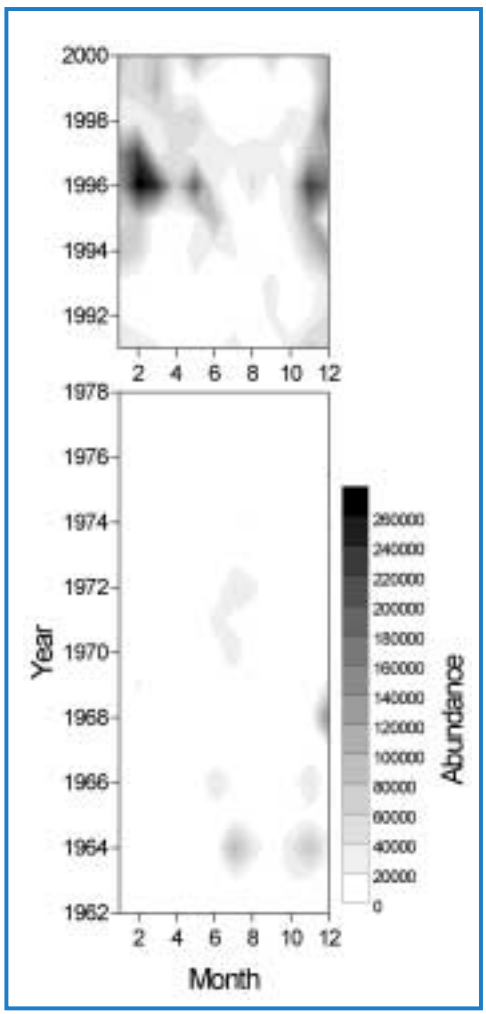


Figure 1. Seasonal and interannual contour plot of Ceratium arcticum.

GTZ / BENEFIT-GLOBEC Workshop on Long-term Dynamics of the Benguela and Humboldt Current Upwelling Ecosystems a Comparison from the Ecosystem Perspective

Jürgen Alheit, Baltic Sea Research Institute, Warnemünde, Germany
(juergen.alheit@io-warnemuende.de)

The seas off the west coasts of southern Africa and South America are dominated by strong upwelling of nutrient-rich water giving rise to high biological production supporting large, heavily exploited fish stocks. The species composition in both ecosystems is very similar, e.g. the commercial fishery is dominated by five main species: sardine, anchovy, mackerel, horse mackerel and hake. Also, the physical forcing driving the two systems appears to be very similar and might even be linked via atmospheric teleconnections. Both, the Humboldt and the Benguela Current, are subject to periodic inflow of warm water called Pacific and Benguela Nino, respectively, causing drastic changes in the ecosystem components and playing havoc with the fisheries. Fisheries scientists and oceanographers as well as fisheries and ecosystem managers of the riparian countries of both upwelling systems are confronted by the same set of problems. Consequently, an exchange of experiences and discussions on how to solve the problems of fisheries and ecosystem management and on how to mitigate the problems caused by external forcing would be of mutual benefit to marine scientists studying both ecosystems.

NatMIRC (National Marine and Information Centre, Swakopmund, Namibia) organized a workshop from 4-15 November 2002 on Long-Term Dynamics of the Benguela and Humboldt Current Upwelling Ecosystems - a Comparison from the Ecosystem Perspective. The goal of the workshop was bringing together marine scientists from the fisheries institutes of five southern hemisphere countries bordering upwelling systems to exchange information and experiences and to discuss fisheries and ecosystem management issues of mutual interest with the aim to initiate and foster future southern hemisphere co-operation. The workshop was funded by GTZ (German Agency of Technical Co-operation), BENEFIT and the US Office of Naval Research and organized by GOPA/COFAD.

Prior to the workshop, all participants were asked to prepare background papers on physical oceanography, plankton, pelagic fisheries, demersal fisheries, top predators (birds and pinnipeds) and ecosystem dynamics of their respective countries. The resulting 22 papers were sent to all participants before the meeting so that everybody would arrive in Namibia with the same state of knowledge. 26 marine scientists from Angola, Chile, Namibia, Peru and South Africa met to exchange experiences and expertises.

The participants in the workshop met experts whom they had not met before and with whom they could share their own experiences. They benefited greatly by comparing both ecosystems and exchanging expertises. Also, the meeting was a pure “southern hemisphere” dialogue without interference from experts outside of the regions. Without exception, all participants took an active part in the lively discussions. The participants took great advantage from the intensive work in small groups. All groups decided already after a few days of joint work to aim for joint publications comparing different aspects of both ecosystems. All participants showed great motivation and enthusiasm throughout the meeting and expressed their desire to strengthen co-operation between both regions.

The products of the workshop are: (i) a workshop report with all 22 background papers and the five group reports (soon available as a BENEFIT Report), (ii) a joint comparative overview paper for an international peer-reviewed journal to be written on the 2nd GTZ/BENEFIT-GLOBEC/BCLME Workshop on Benguela-Humboldt Co-operation in Namibia (24-28 March 2003) and (iii) a number of publications to be written in 2003 by joint teams of both regions. At the evaluation of the workshop, all participants strongly supported the idea to continue this new co-operative initiative between the two GLOBEC regions.

Representatives of the sponsoring agencies (left to right): Jürgen Alheit (GTZ/GOPA/COFAD), Jerry Miller (US Office of Naval Research), Burger Oelefsen (Ministry of Fisheries and Marine Resources, Namibia), Neville Sweijd (BENEFIT), Mick O´Toole (Benguela Current Large Marine Ecosystem Project).

IGBP and SCOR clarify their support to OCEANS and GLOBEC

Context Statement

IGBP has completed its first decade of research and in January 2003 will launch a new structure based on a more integrated approach to Earth System science. The approach is based around research in the three major Earth System compartments - atmosphere, land and oceans - and the interfaces between them. Based on this Earth System approach, IGBP aims to have a single project in the oceans, bringing together research on marine biogeochemistry and ecology (full range of trophic levels) as well as integrating appropriate aspects of physical process and human influences in the oceans (cf. the Oceans Vision document). However, given the current structure of marine global change research and the need for continuity in existing work, the realisation of a single, integrated oceans project in IGBP II will require an evolutionary approach of careful planning, consultation, collaboration and integration over a 5-6 year timeframe (between now and 2009).

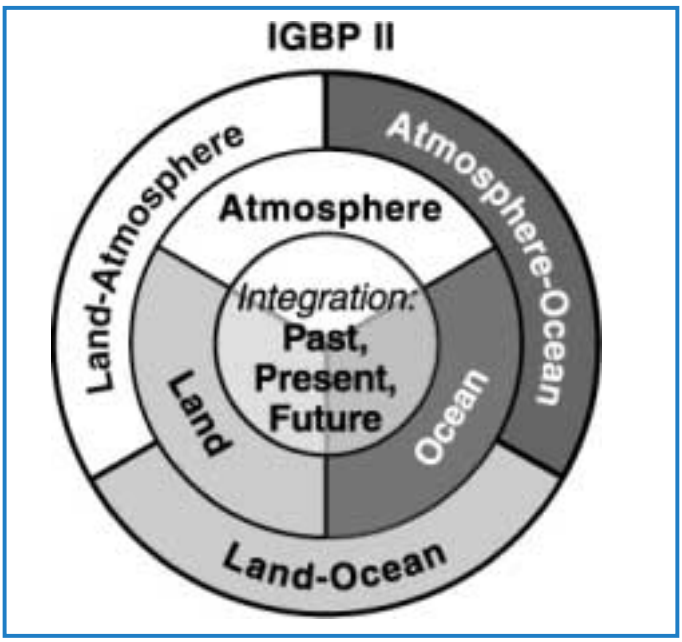
The purpose of the Scientific Committee on Oceanic Research (SCOR) is to stimulate scientific knowledge of the ocean and to promote international cooperation in all branches of ocean science. To achieve this purpose, SCOR *inter alia* (see next article) establishes and supports scientific steering committees for large-scale ocean research projects, related to climate change and other forms of global environmental change, with the International Geosphere-Biosphere Programme and the Intergovernmental Oceanographic Commission.

The new marine research which IGBP and SCOR are building together is aimed at meeting these overall goals while (i) respecting the need for current research activities to continue to their agreed conclusion, and (ii) allowing sufficient time for the various marine research communities to work together in bottom-up fashion towards the eventual goal of a single, integrated ocean project in IGBP II.

Points of Agreement between IGBP and SCOR

1. The Terms of Reference for the Ocean Biogeochemistry and Ecosystems (OCEANS) Transition Team approved by IGBP and SCOR are re-affirmed. This new project has adopted the name 'OCEANS' up to now and will use it through the Paris, January 2003, OSC. However, the final name for the project is a point for further discussion.

2. The new IGBP/SCOR project will include research related to ocean biogeochemistry and biogeochemistry-food web interactions. Its research aims to be



complementary to and linked with, where appropriate, that of GLOBEC.

3. GLOBEC will continue to completion of the project in 2009, as specified in its Implementation Plan.

4. The new project will develop research activities with a ten-year life, with its scientific emphases thus extending until 2014. The project will be allowed to develop its own identity.

5. The new project and GLOBEC will be encouraged to begin to develop joint activities starting in 2003. The co-sponsors will seek new funding for joint activities, but will also encourage the projects to spend part of their regular funding for such activities. The two SSCs will be encouraged to hold back-to-back or overlapping meetings.

6. The extent and speed of development of joint activities and project integration will be at the discretion of the SSCs for the two projects.

7. There will be a single integrated ocean project that includes the scientific activities of GLOBEC and the new project in place by 2009.

8. The IGBP/SCOR Oceans Vision Statement being developed will serve as a scientific guide to help facilitate not only the evolution of GLOBEC and the new project towards a single integrated project, but also to identify important scientific interactions between the new project and the interface programs SOLAS and LOICZ. This will help place all IGBP-SCOR ocean projects in the Earth System science context of IGBP II.

[1] The definition of biogeochemistry by OCEANS is very broad, following Libes (1992). Biogeochemistry is defined as "the science that studies the biological, chemical and geological aspects of environmental processes." Libes, S.M. 1992. An Introduction to Marine Biogeochemistry. John Wiley and Sons, Inc., New York, NY.

Scientific Committee on Oceanic Research (SCOR)

Ed Urban, SCOR Executive Director, The Johns Hopkins University, Baltimore, USA
(scor@jhu.edu)

The Scientific Committee on Oceanic Research (SCOR) promotes international co-operation in oceanography. It was created by the International Council for Science (ICSU) in 1957 as the first of its interdisciplinary bodies, and operates primarily through three types of scientific activities - large-scale research projects, working groups, and advisory bodies and planning groups - supplemented with capacity-building activities. Support for SCOR activities is derived from the annual contributions of national SCOR committees in 38 countries, as well as from grants from national and international government agencies, foundations, and non-profit organizations.

Large-Scale Research Projects

Global-scale issues related to the role of the ocean in environmental change are tackled through SCOR's participation in planning and guiding long-term, large-scale international ocean research projects. For example, international GLOBEC was created by SCOR and UNESCO's Intergovernmental Oceanographic Commission (IOC) in 1991. From 1995 to 2002, SCOR contributed more than $840,000 to international GLOBEC activities, through grants from the U.S. National Science Foundation, U.S. National Oceanic and Atmospheric Administration, ICSU, and other sources. IGBP adopted GLOBEC as an IGBP Core Project in 1995. The now-developing SCOR/IGBP Ocean Biogeochemistry and Ecosystems Analysis activity was described in an earlier *GLOBEC International Newsletter* (Hall, 2002). Another major SCOR-sponsored activity (with IOC) relevant to GLOBEC is the Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) program. This program will study harmful algal blooms (HABs) from perspectives ranging from why the biology of certain species makes them harmful to how large-scale oceanographic conditions can either promote or hinder blooms. GEOHAB shares with GLOBEC a focus on studies of how the physical environment affects marine organisms. GEOHAB will sponsor a series of small open science meetings in 2003 and 2004 to develop detailed implementation plans for GEOHAB activities. The core research of GEOHAB will focus on a small set of specific ecosystem types that are prone to HABs and are found in several locations worldwide: upwelling systems, coastal fjords and bays, and stratified systems, as well as the influence of eutrophication on bloom events and modeling of blooms in coastal systems. GEOHAB will advertise these meetings and it would be beneficial to the program to involve scientists from related GLOBEC activities in the meetings, for example, the Small Pelagic Fishes and Climate Change (SPACC) project in the upwelling meeting.

Working Groups

More specific ocean science topics are addressed by short-lived Working Groups (121 to date), the traditional mechanism by which SCOR has operated since its inception. Throughout its history, SCOR has sponsored many working groups that have contributed to studies of marine fisheries and ecosystems. Examples include WG 67 on Oceanography, Marine Ecology, and Living Resources; WG 73 on Ecological Theory in Relation to Biological Oceanography; WG 76 on Ecology of the Deep Sea Floor; WG 86 on Ecology of Sea Ice; WG 87 on Fine-Scale Distribution of Gelatinous Planktonic Animals; WG 98 on Worldwide Large-Scale Fluctuations of Sardine and Anchovy Populations; and WG 105 on the Impact of World Fisheries Harvests on the Stability and Diversity of Marine Ecosystems. Existing working groups focus on a range of scientific questions that are relevant to GLOBEC:

WG 115 on Standards for the Survey and Analysis of Plankton: How can strategies for continuous sampling of phytoplankton and sampling instruments be improved and integrated with direct plankton sampling approaches?

WG 118 on New Technologies for Observing Marine Life: What are the relative merits of different technologies for observing marine organisms? Which technologies deserve further research and development based on their potential for making significant contributions to the detection of marine life?

WG 119 on Quantitative Ecosystem Indicators for Fisheries Management: What new indicators could be used to study the functional role of species in marine ecosystems and the effects of exploitation and environment? How can such indicators be used in a comparative way to characterize ecosystem states, changes, and functions? What is the utility of these

indicators for management purposes and for the sustainable use of renewable marine resources?

Planning Groups and Advisory Bodies

The third type of SCOR activity includes planning groups and advisory bodies. These presently include the SCOR-IOC Advisory Panel on Ocean Carbon Dioxide and a planning committee for an international symposium on the science needed to anticipate the condition of the ocean in a high-CO_2 world.

Capacity-Building Activities

In addition to its scientific activities, SCOR conducts an active program of capacity building for developing nations and nations with economies in transition. Such nations conduct significant ocean research programs on national and regional scales, but are often under-represented in major international ocean research projects. SCOR attempts to increase the involvement of scientists from such countries by awarding travel grants for their scientists to participate in ocean science meetings. Travel funds have been provided for many GLOBEC meetings, including the 2002 GLOBEC Open Science Meeting in Qingdao, China and the upcoming ICES-PICES-GLOBEC Zooplankton Production Symposium in Gijón, Spain. SCOR also participates in a fellowship program designed to promote ocean observations (together with the Partnership for Observation of the Global Oceans and IOC).

Reference

Hall, J. 2002. New project for the oceans in IGBP II. *GLOBEC International Newsletter* 8(1): p.25.

Social Scientists go to GLOBEC

Ussif Rashid Sumaila
Fisheries Economics Research Unit, Fisheries Centre, University of British Columbia, Vancouver, B.C., V6X 3W2, Canada (r.sumaila@fisheries.ubc.ca)

The GLOBEC (Global Ocean Ecosystem Dynamics) project held its Second Open Science Meeting from October 15-18 October, 2002 in Qingdao, China. From my perspective as an economist, the interesting thing about this meeting is that three social scientists - Rosemary Ommer of the University of Victoria, B.C., Canada, Kenneth Broad of the University of Miami, USA, and I, representing both the Sea Around Us Project and the Fisheries Economics Unit of the Fisheries Centre, UBC - were invited to give plenary presentations to a group consisting essentially of natural scientists. R. Ommer presented her work with Ian Perry, of the Department of Fisheries and Oceans, Canada, on "Scale issues in marine ecosystems/human interactions"; K. Broad spoke about "Climate, culture and scientific uncertainty: the case of Peruvian fisheries", and I presented my work on "Discounting: A crucial link in the interaction between coastal communities and global changes in marine ecosystem."

It was amazing to see the amount of discussion that these presentations generated given the interest of the audience. I think this is a good sign for the future of marine ecosystem management: The more we get social and natural scientists talking to each other, the better the prospect of fixing some of our resource problems.

GLOBEC is a core project of the International Geosphere-Biosphere Programme (IGBP), and is tasked with elucidating how global change will affect the abundance, diversity and productivity of marine populations (www.globec.org). GLOBEC is focused on zooplankton – the assemblage of herbivorous grazers on the phytoplankton and the primary carnivores that prey on them, which are the most important prey for larval and juvenile fish, and hence have a crucial role in marine ecosystems.

So, if GLOBEC is focused on zooplankton, what were social scientists doing at one of its meetings? I think this is because, increasingly, scientists are discovering and acknowledging that understanding the problems of ocean ecosystem dynamics, and their downstream effects on humans, and devising science-based solutions to them is outside the scope of any one discipline. For this reason, GLOBEC intends to expand the involvement of social scientists in its work – a laudable and necessary move, which other global marine research endeavors may need to emulate in the interest of reaching the broad understanding of the interactions between humans and marine ecosystems that is required as a basis for management advice.

Ocean Biogeochemistry and Ecosystem Analysis (OCEANS)

Julie Hall, NIWA, Hamilton, New Zealand (j.hall@niwa.co.nz)

IGBP and SCOR are developing a new project on Ocean Biogeochemistry and Ecosystems Analysis (provisional name OCEANS). Its goal is to understand the sensitivity of the ocean to global change, focusing on biogeochemical cycles, marine food webs and their interactions in the context of the Earth System. It will seek a comprehensive understanding of the impacts of climate and anthropogenic forcings on food web dynamics (i.e. structure, function, diversity and stability) and elemental cycling (i.e. biogeochemical pathways, transfers and cycling), including the impacts of underlying physical dynamics of the ocean. It will also strive for a mechanistic and predictive understanding of how these linked systems respond to global change resulting from climate modes (e.g. El Niño Southern Oscillation, North Atlantic Oscillation, etc.) and anthropogenic perturbations.

The new OCEANS project is being established as part of the second phase of IGBP, and will work closely and collaborate with existing projects such as Global Ocean Ecosystem Dynamics (GLOBEC), the Land-Ocean Interactions in the Coastal Zone (LOICZ), and the Surface Ocean – Lower Atmosphere Study (SOLAS). To develop the OCEANS Science Plan/Implementation Strategy, an open science conference was held in Paris 7-10 Jan 2003. The main aim of the conference was the gathering of input from the scientific community to assist in the development of the science focus of the new project. The conference started with 15 plenary lectures, these were followed by working group discussions. In addition there were 2 poster sessions with a total of 200 posters presented, the abstracts of which are available on the website. In total the conference was attended by 370 participants, from 36 countries.

The ten Working Group sessions provided the main opportunity for attendees to participate in developing the scientific focus of the new project. The working group titles were: Trace elements in ecological and biogeochemical processes; Physical forcing of biogeochemical cycling and food webs; Climate modulation of organic matter fluxes; Direct effects of anthropogenic CO_2 on biogeochemical cycles and ecosystems; Integrating food web dynamics from end to end; Continental margins; Mesopelagic layer; Biogeochemical hotspots, choke points, triggers, switches, and non-linear responses; Feedbacks to the Earth System; Coupled models of biogeochemical cycles and ecosystems.

The working groups were asked to identify and prioritise key research questions and what it was we needed to know to answer those questions. They were also asked to identify any promising approaches, emerging technologies, or regional considerations which might be necessary. In addition to the working group discussions, short oral reports were given on the current national and international activities and any future plans relevant to the development of the OCEANS project. The conference programme, abstracts, and final working group reports are available via the Web site www.igbp.kva.se/obe/

Several working groups were relevant to the GLOBEC community, including the group on Integrating food web dynamics from end to end. Michael St. John led this session, assisted by Angelica Peña, and they presented a summary report to the conference. Their written report was produced with the input from the entire group, with special assistance from Charles Hannah, Katherine Richardson, Ian Perry and Lewis Incze. Several overarching themes which could be developed for the OCEANS project were identified, specifically focusing on the ability to predict the future behaviour of marine ecosystems and their emergent properties. The group accepted that humans are a key influence on every ecosystem and that the need to address the impact of the human influence is important.

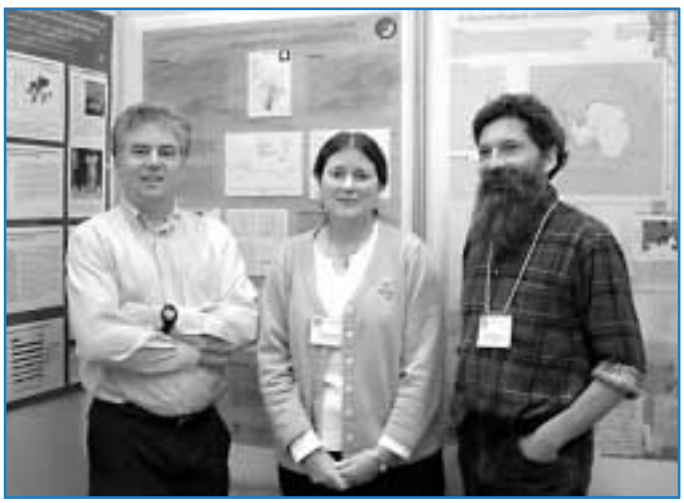
Several potential themes for GLOBEC/Ocean Biogeochemistry and Ecosystems Analysis collaboration were identified by the working group. These included: Quantification of the biota's role in determining elemental flux between global compartments (e.g. identification of key species, elemental fluxes through food webs); Determination of the nature of changes in ecosystem state and development of techniques to monitor/predict them (e.g. effects of climatic and elemental cycles on life cycles, biodiversity, human impacts on food webs); and The role of adaptation for global change and its effects on ecosystem dynamics (e.g. how do communities respond to environmental changes).

Input from the working groups, plenary speakers, comments from the web, along with other material is being used by the OCEANS Transition Team to identify the key science themes and questions which will form the scientific focus of the new OCEANS project. The timeline for the development of the Science Plan/Implementation Strategy (to be produced as a single document) is to have the themes and key questions identified for discussion at the IGBP congress (Banff, Canada on 20-23 June 2003). A full draft will then be available via the Web site (and through email notification to conference participants) in September/October 2003. We encourage the scientific community to read and comment on this draft. The final Science Plan and Implementation Strategy is expected to be completed by the end of 2003 for review by IGBP and SCOR.

Photographs from the GLOBEC 2nd Open Science

The GLOBEC SSC and representatives of IOC, SCOR and IGBP relax on the last day of the conference.

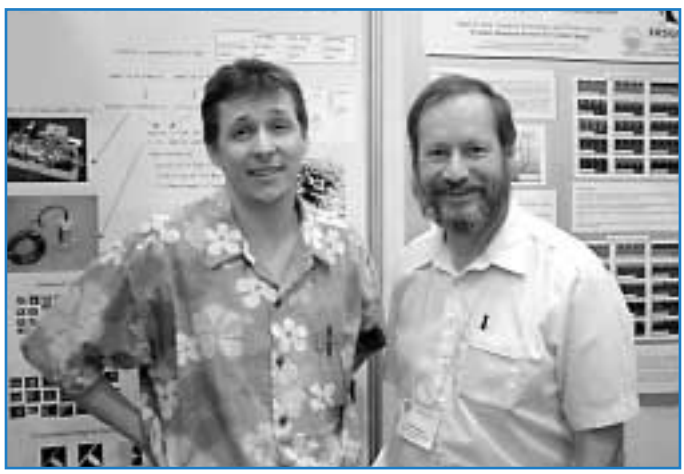
Skip McKinnell and Jürgen Alheit sample Chinese wines



Steve Nicol, Eileen Hofmann and Ulrich Bathmann talk things Antarctic

The OSM gathered over 250 scientists in a beautiful venue

The support of the Chinese academic community was encouraging



Patrick Lehodey and Ken Drinkwater at the poster session

Meeting, Qindao, P.R. China, 15-18 October 2002

A well attended conference

Roger Harris, SSC Chair 1996-2002, wishes attendees well

Qisheng Tang and Serge Poulet talk copepod

The OSM banquet was a good opportunity to surprise guests

Lotty Ireland and Tamara Shiganova

Hester Willson, Takashige Sugimoto and Sonia Batten

The Invasion of the Black, Mediterranean and Caspian Seas by the Ctenophore, Mnemiopsis leidyi: A NATO ARW Workshop held in Baku (Azerbaijan) on 24-26 June 2002

Henri Dumont[1] & Tamara Shiganova[2]
[1]Ghent University, Belgium (Henri.dumont@rug.ac.be)
[2]P.P.Shirshov Institute of Oceanology RAS, Russia (shiganov@sio.rssi.ru)

A NATO Science programme workshop was held in Baku (Azerbaijan), 24-27 June 2002, organized by Henri Dumont (Ghent University, Belgium) and Tamara Shiganova (P.P. Shirshov Institute of Oceanology RAS, Russia) with the help of the GEF Caspian Environment Programme. The workshop was devoted to the invasion of ctenophore *Mnemiopsis leidyi* into the Seas of the Mediterranean basin and more recently into the Caspian Sea.

The first phase of the workshop addressed the invasion of the Black Sea by the carnivorous ctenophore *Mnemiopsis leidyi*. A review was presented of the ecological and economic consequences of the invasion, and of the new situation created since 1997 by the appearance of a new invading ctenophore, *Beroe ovata*, which feeds quasi-exclusively on *Mnemiopsis leidyi*. Both introductions are believed to have been the result of ballast water exchange by intercontinental ships, and both invaders are clearly derived from the East coast of the Americas. Confirmation of this conjecture has now been obtained by morphological and molecular methods (ITS-segments of the nuclear ribosomal genes), as explained by two of the symposium participants.

Beroe reversed the disastrous situation in the Black Sea, reduced *Mnemiopsis* to low levels and, in the wake of its decimation, zooplankton and fish recruitment became restored to almost pre-*Mnemiopsis* levels. No species appear to have been lost from the Black Sea fauna in the process even if, at the height of the *Mnemiopsis* outbreak, many fell to levels so low as to make their observation impossible.

The prediction in 1995 that *Mnemiopsis* would sooner or later make it to the Caspian Sea was confirmed in 1999, and its expansion since has been even more rapid than in the Black Sea. Several presentations by representatives of Caspian countries depicted the situation up to the week before the meeting. Except in the Kazakh sector, where the water is almost fresh, the situation is alarming everywhere. Figures for 2002 depict high invasion levels in the centre and south regions, compared to 2001. It is noteworthy that individuals of *Mnemiopsis* in the Caspian are much smaller and mature at a much smaller size than in the Black Sea. However, their numbers are higher, such that it may be anticipated that biomass levels by September 2002 in the south will largely overshoot 3 kg m^{-2}. Maturation at smaller-than-normal size is generally a sign of stress, possibly because of food limitations; The largest specimens occur in the North, where food conditions are better but salinities lower.

Figure 1. Mnemiopsis leidyi from the Caspian Sea

Effects on zooplankton and their traditional consumers, kilka fish (pure zooplanktivores), are now expected to result in a total collapse. Zooplankton, which used to contain up to 25 species of crustaceans, is now reduced to a single species (*Acartia tonsa*), itself an invader. *A. tonsa* has strong spines on its antenna, which may offer some protection from *Mnemiopsis*. This combined with rapid reproduction, effective evasion techniques (vertical migration out of the range of the surface-subsurface bound *Mnemiopsis*) and excellent swimming capabilities would explain its success. It was found that there is a need for direct observation of *Mnemiopsis* and its prey (either in aquaria, or in the natural environment, using video techniques); most studies are time series in *in situ* conditions, and these may raise a number of interesting questions, but not solve them. In the Caspian, it has now been found that, as had been predicted, *Mnemiopsis* is present throughout the year in the Southern area, even if the numbers decrease considerably in winter, when the temperature drops to 8-10° C.

Lack of sufficient kilka food has already triggered arrested reproduction in Caspian seal, one of the lake's flagship species. Seals have been suffering from canine distemper virus in the past few years, and were subject to considerable mortality. Lack of food may deliver the final blow to a species that is represented by less than 300,000 individuals.

Before embarking on a discussion on remedial actions, the Ponto-Caspian invasions were discussed against the broader background of similar invasions in the Mediterranean and Baltic seas. Not only jellies were included, but other groups, even *Caulerpa* (marine macroalgae) as well. It was also pointed out that the Ponto-Caspian is not only a target for invasive species, but a donor as well. The connecting and damming of all major rivers of Europe and part of West Asia has now resulted in a number of euryhaline, eurythermic Caspian species, mainly crustaceans, but also molluscs and cnidarians to expand, often displacing native species in the process.

Figure 2. In the conference hall.

One case of a cnidarian (*Pelagia*) which expanded from the central to the north of the Adriatic Sea in the 1980s, is to be considered a "natural" expansion, but for the fact that eutrophication may have facilitated its range extension to an environment with a possibly suboptimum salinity.

A full half day was devoted, finally, to attempting to integrate all the information tabled, which will be collected as well in a proceedings book, and an effort was made at formulating the pros and cons of remedial actions to be taken, particularly in the case of *Mnemiopsis* and *Beroe*.

Temperature, salinity, and food range (size and type) were considered the controlling factors on aquatic invasions. Further, rapid development from egg to maturity (short development time), high lifetime fertility, and a mode of reproduction involving either vegetative propagation, or unisexual (parthenogenetic) reproduction, or self-fertilisation frequently occur. The mode of feeding of an explosive invader can be very different: autotrophic or allotrophic, with many species actively hunting carnivores. An absence or scarcity of species able to consume the invading species themselves was found to be a rather strong condition to success in the vast majority of cases documented. Conversely, presence of an abundance of food for the invader, with the prey often absolutely naive to the new predator (absence of co-evolution) was a final factor identified.

A combination of two among these factors was found sufficient to guarantee a successful invasion in the cases examined. The last two (much food, no predators) lead to an unusual (much higher than normal) survival rate in the invading population, and seems to be a strong precondition for the establishment of a viable invading population.

With the *proviso* that a combination of 2-3 of the above-cited factors might be required, it was estimated that there may be thousands of man-mediated aquatic introductions per annum, yet of these only a few may lead to success and subsequent explosive development of the invader.

The question raised next was whether such theoretical considerations might help in combating an invasion like that of *Mnemiopsis* in the Black and Caspian seas which was seen to have – first and foremost- grave economic consequences. In the case of the Caspian lake, there is an acute danger for considerable damage to the large number of endemic crustaceans of this ancient ecosystem as well.

It was felt that, even though the perception of the damage caused by *Mnemiopsis* was largely anthropocentric (all ecosystems have evolved through space and time in the past, and the acceleration caused by some introduced species is therefore not a qualitatively new and different phenomenon), it might nonetheless cause significant and irreversible species losses and these should be counteracted.

Can measures be taken, and if yes, should they be taken? Again, the anthropocentric point of view was thought to be important: can we tolerate that large number of fishermen in Iran and Azerbaijan lose their livelihood and investments? A cost-benefit analysis should be conducted, in any case, as well as an EIA.

The participants, some of which had also participated in the GESAMP-expert group and its meetings over the solution of the *Mnemiopsis* problem in the Black Sea, argued that, since the days of their report (1995), the scientific position on counter-measures had not changed substantially: *Beroe* was the best possible biological agent currently known and available, chemical and physical eradication methods being out of the question in the case of a lake the size of the Caspian.

One new fact had emerged, however: the "spontaneous" emergence of the North American *Beroe ovata* in the Black Sea at the end of the 1990s in the Black Sea. This species has brought about a tremendous improvement of the situation of that sea in the last three years. No appreciable negative side-effects have been recorded, and thus the cost/benefit analysis is absolutely positive towards *Beroe*.

Laboratory experiments with *Beroe* adjusted to Caspian water (a process that takes about three days, using Black Sea-derived *Beroe*) confirm the south Caspian aquatic environment as adequate for *Beroe*, even if its full cycle culture in this medium has not (yet) been achieved.

Of course, it may be argued that there always exists a residual risk, like that of co-introduced parasites and pathogens, but no such effects have so far been observed in the Black Sea. In all probability, they will therefore not occur.

It was stressed that *Beroe* is not likely a miracle solution: it is a thermophilic species, less tolerant of low salinity than *Mnemiopsis*, and a hyperspecialist equipped with digestive enzymes that can only degrade other ctenophores. *Inter alia*, this makes it unlikely that this species will "spontaneously" reach the Caspian lake in the near future. But it is also a voracious feeder, meaning that it needs many prey to survive and thrive. As a result, it only peaks after the abundance peak of its prey, which it rapidly reduces to low numbers, but thereafter it collapses itself. This nice example of an oscillating predator-prey couple in the sense of Lotka-Volterra dynamics can go on forever. It is highly unlikely that such

a predator will eliminate its prey completely, and therefore, we will have to live with both jelly species in the Caspian environment, albeit at tolerable levels.

In the longer term, other solutions can be thought of, since the prospect of a Caspian with two, not one, ctenophore is not altogether brilliant. Introducing a fish like *Peprilus*, the butterfish, might be contemplated. This American marine fish species is another obligate jelly feeder, and it is also considered a very tasty table fish. Unfortunately, this species is difficult to handle, and will often not survive capturing by nets. Moreover, little is known about how and where it reproduces, such that egg transport is not (yet) feasible. However, studies to fill these hiatuses should now be planned with high priority. Subjects which need documentation are the food regime (diet), and means to acquire control over the reproductive cycle. Parasites and diseases should also be studied.

Should all these tests turn out positive, an introduction of *Peprilus* (even if it is a vertebrate, and most deliberate vertebrate introductions so far have to some degree missed their aims) should be considered, providing a means to transform unusable jelly into valuable biomass.

The final conclusion of the workshop may thus be summarised as follows: all available wisdom strongly suggests to introduce *Beroe* to the Caspian as soon as possible, preferably in September 2002, and immediately thereafter initiate studies on *Peprilus* or fish with a similar feeding regime, as a medium-term possible final remedy.

Co-directors

Vladimir Vladimirov (PCU); Henri Dumont (Ghent University, Belgium); Tamara Shiganova (P.P. Shirshov Institute of Oceanology RAS, Russia); Alain Jubier, (NATO); Ahmet Kideys (Institute of Marine Sciences METU, Turkey); Melek Isinibilir (Istanbul University, Turkey); Henk A. M. Ketelaars (Water Storage Company Brabantse Biesbosch. Werkendam, Holland); Thiéry Thibaut (Littoral Marin, Université de Nice, France) Ludmila Kamburska (Institute of Oceanology, BAS, Bulgaria).

MAR-ECO - "Patterns and Processes of the ecosystems of the Northern Mid-Atlantic"; an international project under the Census of Marine Life programme

Odd Aksel Bergstad[1] & Uwe Piatkowski[2]
[1]Institute of Marine Research, Norway (oddaksel@imr.no.)
[2]Institute for Marine Research at the University of Kiel, Germany (upiatkowski@ifm.uni-kiel.de)

MAR-ECO – a North Atlantic biodiversity study

Despite the wide distribution and extensive area of mid-ocean ridges, relatively few previous investigations have been dedicated to the study of the animal communities inhabiting these vast areas of the world ocean. Ridges may have characteristic faunas, but they may also significantly influence the processes affecting the slope and shelf biota such as intercontinental migration and dispersion. This forms the background of MAR-ECO (http://www.mar-eco.no/), a project focusing on the macrofaunal communities associated with the Mid-Atlantic Ridge (MAR) between Iceland and the Azores. MAR-ECO has the status of an international ecosystem study under the Census of Marine Life (CoML, http://www.coml.org) programme.

The overriding aim is to describe and understand the patterns of distribution, abundance and trophic relationships of the organisms inhabiting the mid-oceanic North Atlantic, and identify and model ecological processes that cause variability in these patterns. Fish, crustaceans, cephalopods, and gelatinous plankton and nekton have the highest priority in the study, but there will also be some effort devoted to epibenthic communities. The project will be carried out as a multi-ship operation in 2003-2005, with most activity in 2004 centered around a two-month cruise on the Norwegian *RV G.O. Sars.*

Science Plan, tasks and hypotheses

The Science Plan (available on the website http://www.mar-eco.no/) presents the three central tasks of MAR-ECO, and a compilation of hypotheses and suggestions resulting from discussions during and after an initial workshop held in Bergen 12-13 February 2001:

Task 1: Mapping of species composition and distribution patterns.

Theme 1: Identity and distribution patterns of macrofauna.

Theme 2: Population genetics and dispersion studies.

Task 2: Identification of trophic interrelationships and modelling of food web patterns

Task 3: Analyses of life history strategies

The three tasks are obviously inter-related, and all the tasks rely on a thorough understanding of the abiotic environment (bathymetry, water mass properties and distributions, circulation). A major challenge of the project is to overcome observation difficulties at large depths and in rugged terrain. A central aim is thus to utilise modern remote sensing technology (acoustics, optics) using advanced instrument carriers (e.g. towed vehicles, ROVs, AUVs etc.), in addition to more traditional samplers and observation methods.

Some basic overall hypotheses or questions to be addressed are:

a) Are the MAR communities extensions of the

communities inhabiting the North Atlantic continental slope regions?

b) Is the MAR a barrier between the pelagic fauna of the east and west North Atlantic basins? Is there a difference in species occurrence either side of the MAR?

c) Do circulation features, e.g. the Gulf Stream, act as barriers between the northern and southern fauna? In the region of the Gulf Stream, what is the effect of eastward drift and import of material from the west?

d) What is the significance of seamounts within the ridge system?

e) Is the trophic structure of the northern mid-Atlantic ecosystem similar to that on the slope regions of the eastern and western sides of the Atlantic?

Organisation and schedule

The International Steering Group organises and oversees the planning, financing and implementation of the project. Members of the group are:

Dr. Odd Aksel Bergstad, IMR, Norway (chairman)
Prof. Dr. Peter Boyle, University of Aberdeen, UK
Dr. Olafur S. Astthorsson, MRI, Iceland
Dr. Ricardo S. Santos, University of the Azores, Portugal
Dr. Uwe Piatkowski, Institute for Marine Research at the University of Kiel, Germany
Dr. Michael Vecchione, NOAA, NMFS, USA
Dr. E.M. Burreson, Virginia Institute of Marine Science (VIMS), USA
Prof. Dr. Ulf Båmstedt, University of Bergen, Norway
Dr. Pascal Lorance, IFREMER, France

Norway has taken on the secretarial duties for the project, and the responsible institution will be the Institute of Marine Research (IMR) in collaboration with the University of Bergen. The new Norwegian research vessel *RV G.O. Sars* will be at the disposal of the project activities in 2004, and may form a central focus of international multi-vessel operations.

The schedule and phases of MAR-ECO are the following:

Planning phase:	2001-2003
Field phase:	2003-2005
Analysis, synthesis:	2004-2008
Incorporation into OBIS:	2005-2008

Current status

A planning grant recently awarded enables the International Steering Group to stimulate the network of experts to formulate component projects, and a first planning workshop was held in the Alfred Wegener Institut für Meeresforschung in Bremerhaven in early January 2002 to facilitate presentation of the project and co-ordination of the component project building. Some 45 experts from around the North Atlantic gathered to focus on component project formulation. The following is a list of the working titles of MAR-ECO studies now being fomulated:

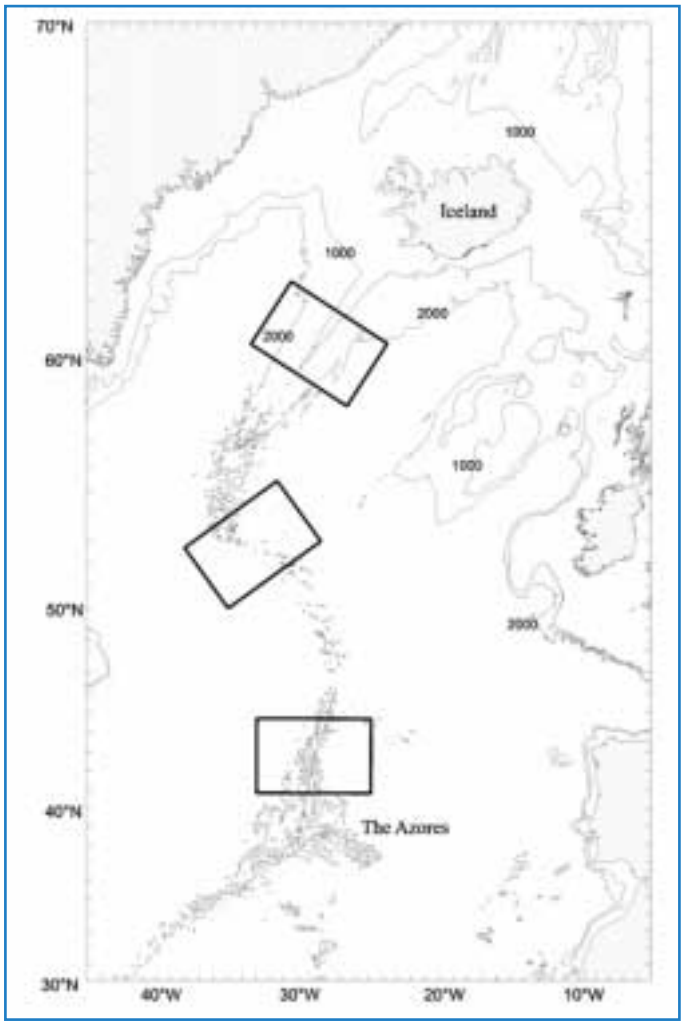


Figure 1. The Mar-Eco area with sub-areas selected for detailed studies. The exact locations are to be decided during the planning phase.

Zooplankton studies:

- Distribution, abundance and species composition of zooplankton in cross-frontal and cross-ridge transects of the Mid Atlantic Ridge. PIs: Webjørn Melle and Tone Falkenhaug, Institute of Marine Research, Norway.
- Feeding behaviour and swimming mode of gelatinous zooplankton and nekton. PI: Ulf Båmstedt, University of Bergen, Norway
- Time-scale distribution and trophic structure of deep-water gelatinous zooplankton and nekton. PI: Marsh Youngbluth, The Harbor Branch Laboratory, USA
- Trophic structure of major copepods, euphausiids and fish larvae across the Mid Atlantic Ridge. PI: Astthor Gislason, Marine Research Institute, Iceland.

Pelagic nekton:

- Longitudinal and latitudinal changes in mesopelagic/bathypelagic nektonic fauna (fish, cephalopods and crustaceans) along MAR. PIs: Uwe Piatkowski, Institute for Marine Research at the University of Kiel, Germany, and Filipe Porteiro, University of the Azores, Portugal.

- Interactions of mesopelagic and bathypelagic fauna with the benthopelagic community associated with MAR seamounts/ slopes. PIs: Bernd Christiansen, University of Hamburg, Germany, and Åge Høines, IMR, Norway.
- Effects of the Sub-polar Front on MAR pelagic communities. PI: Peter Boyle, University of Aberdeen, UK.
- Life cycles strategies of selected species living in different water masses. PIs: Roger Villaneuva, Institut de Ciencias del Mar, Barcelona, Spain.
- Fertilisation experiments with fish and cephalopods for egg and larvae description/ recognition. PI: Sergey Evseenko, Shirshov Institute of Oceanology, Moscow, Russia.
- Evaluation of global changes comparing catch of historical cruises with present day. PIs: Filipe Porteiro and Ricardo S. Santos, University of the Azores, Portugal.

Demersal nekton studies

- Distribution patterns and species composition of demersal fishes in relation to habitat variability on the Mid-Atlantic Ridge. PIs: Franz Uiblein, University of Salzburg, Austria, and Odd Aksel Bergstad, IMR, Norway.
- Spatial genetic structure of commercially valuable deep-sea fish from the North Atlantic. PI: Rus Hoelzel, University of Durham, UK.
- Epibenthic and Benthopelagic (Demersal) Invertebrate communities, distribution and ecology. PI: David Billett, Southampton Oceanography Centre, UK
- Life history studies of demersal fishes. PI: Maurice Clarke, Marine Fisheries Service, Ireland

The Mar-Eco vision

The MAR-ECO vision is that, following the 2001-2008 project period, the identity, distribution patterns, food-webs and life history patterns of the macrofaunal communities of the northern Mid-Atlantic Ridge and its flanks will be understood and well known both to the scientific community and the interested public.

The website http://mar-eco.no/ is the main source of updates, contact information, and documents relevant to the project.

The CNP Long term program to measure the impact of ENSO in the Southern Ocean through elephant seals

Daniel F. Vergani & Zulma Stanganelli,
CNP, Puerto Madryn, Argentina (atlas@cenpat.edu.ar)

Introduction

Major effects of El Niño - La Niña anomalies on the Antarctic ecosystem may be related to the seasonal variability of the pack-ice zone. This zone is the most productive area in the Antarctic region on an annual basis and although monthly ENSO fluctuation appears to be linked with monthly fluctuations in Western Antarctic Peninsula (WAP) sea ice extent no direct evidence of changes in food availability to the female elephant seals has been described in these periods.

Elephant seals constitute one of the most fascinating examples of adaptation in mammals living in the marine environment. Purely by investment of their reserves females raise the mass at weaning of pups to almost three times the birth mass in the average of 23 days. The fasting capacity of nursing females and the mass reached by their pups represent a sensitive mechanism reflecting the success of their selected strategy to choose a feeding ground during pregnancy, physical influences and biological factors as well.

The growth of the pup from birth to weaning depends exclusively on the energy transferred from the mother and, as a consequence, the ultimate weaning mass of pups and the suckling length is function of maternal energy reserves. Although these investment patterns are not a linear function of maternal energy reserves, they provide a potentially useful indication of maternal energy reserves.

Links between physical processes such as ENSO and biological processes remain largely unknown. The balance between them depends on the regions and components involved. Nevertheless it is widely accepted that changes in population parameters of top predators reflect direct, indirect and interlinked influences of biological and physical environmental variables. The main goal of this project in the first stage was to test the usefulness of suckling parameters of southern elephant seals as an indicator of changes in food availability under the influence of Climate Variability in the Western Antarctic Peninsula (WAP) Region.

Data collection started in 1980 and finished in 1994 at King George Island (Isla 25 de Mayo) (62º14´S, 58º30´W). Logistic support was provided by the Direcion Nacional del Antartico under the agreement DNA-CONICET (CNP-IAA Project). First presentation of results was made at the VII SCAR Symposium of Antarctic Biology held in Hobart (Australia, 1988). Analysis of the information was followed up during the Fundamental and Applied Marine Ecology Master Programme carried out by Zulma Stanganelli (1994-1996) at the Vrije Universiteit Brussel (VUB) (Belgium) with a grant by the World Bank. The results of this stage were presented at the VII Symposium of Antarctic Biology held in Christchurch (New Zealand, 1998). The programme has been continued since 1997 at Centro Nacional Patagónico (CENPAT), Puerto Madryn, where the integration of biological and environmental data

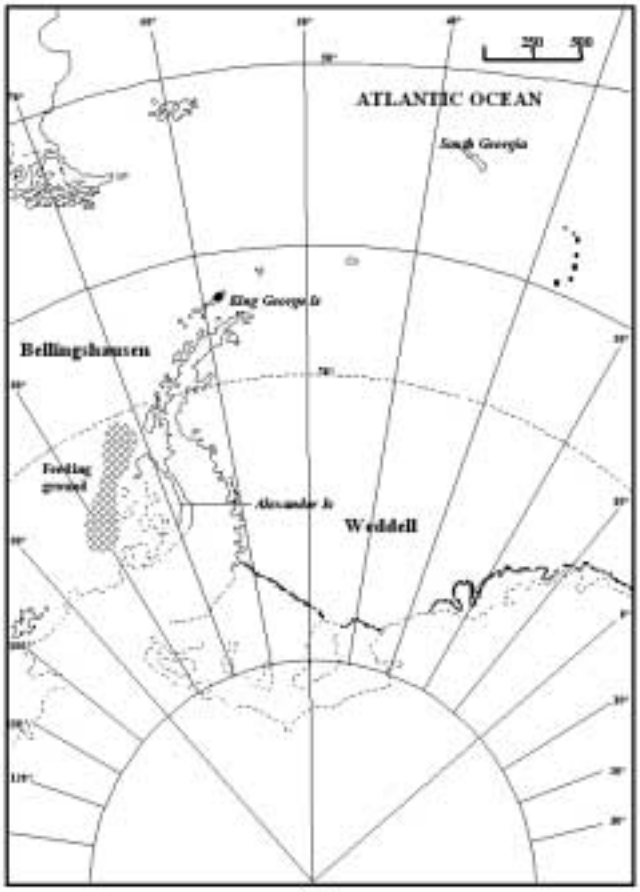


Figure 1. Female elephant seals feeding ground from King George Island (Published in Vergani et al 2001, presented here with the permission of Cambridge University Press)

started in the frame of Cyber Antarctic Atlas Project leaded by Dr. D.R.F. Taylor (Carleton University, Canada) under Argentine (CENPAT), Belgian (VUB) and Canadian (Carleton University) cooperation.

The primary objectives of this first stage were:

- To determine the population fluctuation and suckling parameters of southern elephant seals at King George Island in a long term period.
- To determine the variation in prey items during this period.
- To determine the feeding grounds of females elephant seals.
- To test relationship between biological and physical parameters in the study period.

Methodology

Population Fluctuation and Suckling Parameters

Variation in population parameters was determined by counts of hauled out breeding adults and pups since 1980 to 1994. Suckling parameters measured for this experience were: weaning mass, suckling length and birth weight. Weaning mass of representatives samples were measured since 1985 to 1994. Additional parameters, birth mass and suckling length, were measured in 1985, 1986, 1988, 1989, 1990, 1991 and 1992.

Variation in Prey Items

Samples of stomach content were obtained from female elephant seals in 1992 and 1993. Sample analysis was made in co-operation with the Institute für Meereskunde Kiel University (Germany)

Determination of Feeding Grounds

Feeding ground for females from King George Island was determined according to the information obtained from 13 females attached with Argos satellite transmitters (ST-10 Telonics, Mesa, AZ, USA and SDR T-6 Wildlife computers, Redmond, WA, USA) through joint work carried out with the Alfred Wegener Institute (Germany) in the frame of co-operative agreement between Argentina (SECYT) and Germany (Alfred Wegener Institute) Project Antar II.

Relationship between Biological and Physical Parameters

Primarily to determine the occurrence of ENSO during the study period, an index of Sea Surface Temperature (SSTs) called "Niño 3.4" for the region 5ºN - 5ºS, 120ºE-170ºW was applied according to Trenberth (1997). In four occasions the average of SSTs in the Niño 3.4 index exceeded the 0.4ºC threshold for more than 5 months, indicating the occurrence of El Niño (86,87,91,92,93,94). On two occasions the values were under 0.4ºC indicating the occurrence of La Niña event (85,88,89).

Initial Results

- Population changes were observed during "El Niño" years, in 1982, 1986, 1993, and 1994 showed a negative trend. 1986 and 1992 showed a positive increase in the number of females haul out. These changes are associated at changes in distribution and deserves further research.
- Variation in suckling parameters: Weaning mass of elephant seals was found to be higher during "La Niña" and lower during "El Niño".
- Changes in diet composition: the squid *Psychrotheuthis glacialis* constituted the main cephalopod diet of the seals. A reduction in the "Index of Biomass Ingested" by female elephant seals (IBIF) of this prey species was observed in "El Niño" years compared with the "La Niña" year. This reduction in biomass was observed for all squid species in the seals' prey with the exception of *Galiteuthis glacialis* which was more abundant during El Niño years than in La Niña years, although in considerable low numbers
- Females feeding grounds: from March, after moult, females feed until August/September in the Bellingshausen Sea, west of Alexander Island, in close relationship with sea ice extension.

Future Work

In the frame of Cyber Antarctic Atlas we have started to employ in the relationship between Biological and Physical Parameters NCEP/NCAR reanalyzes under the advice of Juan Carlos Labraga from CENPAT (Argentina). Information will be integrated in digital maps

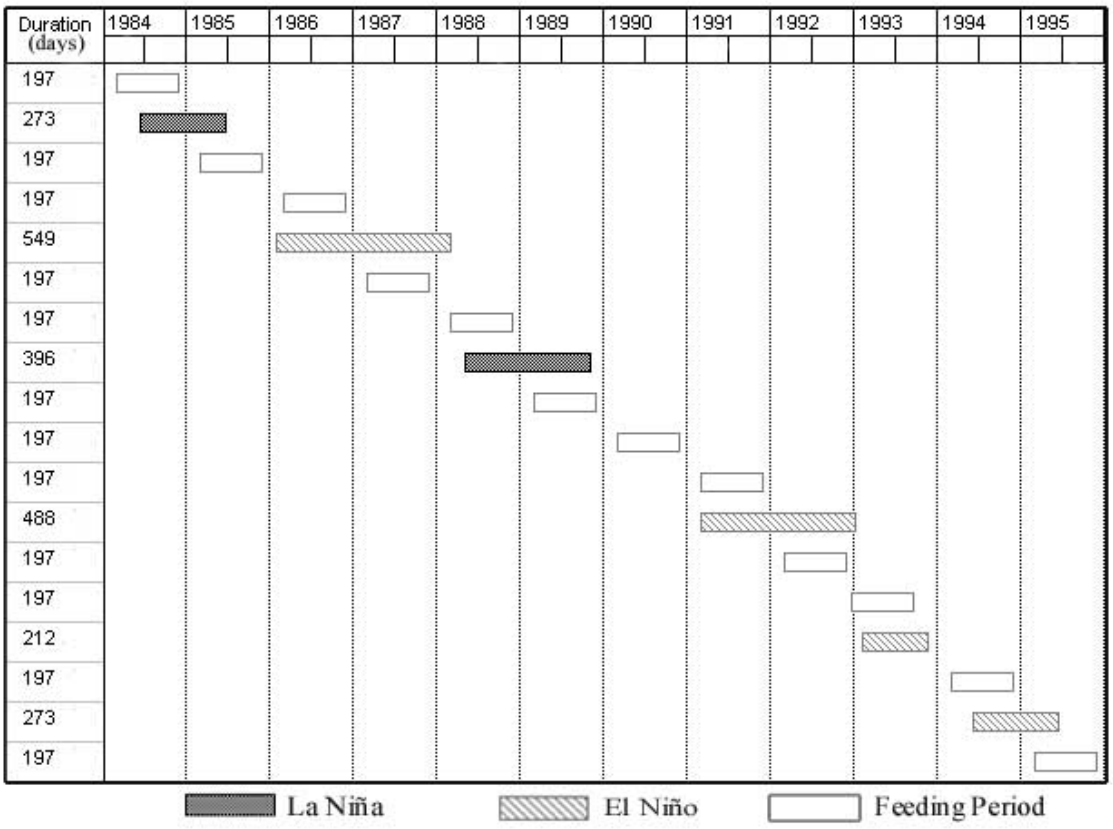


Figure 2. Occurrence of ENSO events and females' feeding period. (Published in Vergani et al 2001, presented here with the permission of Cambridge University Press)

in co-operation with Julio Benedetti from SIGEA (Argentina) and Peter Pulsifer from Carleton University (Canada).

To continue testing different hypotheses new biological data on elephant seal parameters will be taken from the 2002 breeding season at Peninsula Valdes Southern elephant seals breeding colony with the Belgian project led by Ludo Holsbeek from the VUB.

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GLOBEC publication database goes interactive

Dawn Ashby
GLOBEC IPO, Plymouth, UK (d.ashby@pml.ac.uk)

The GLOBEC publication database has been extensively updated with over 200 new references added. The references have been imported into an Endnote database which is published on the GLOBEC webpages (http://www.globec.org/) using Reference Web Poster software. From the database it is possible to search for publications by authors, words in title or keywords and to download records directly into a Reference Manager or Procite database.

It is important to keep the bibliography as comprehensive as possible. Alerts have been set up with commercial databases to inform the GLOBEC IPO of new GLOBEC publications, but as the reference to GLOBEC is not always in the title or abstract of a paper it is impossible to locate all GLOBEC publications in this way. Therefore it is an important part of your role in the GLOBEC community to keep the IPO informed of any GLOBEC publications. This can be done by using the form on the webpages or by sending an e-mail to d.ashby@pml.ac.uk with full details of the publications.

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A comprehensive guide to using the database can be found from the help button, below is a short summary of the main features.

Quick search

There are two search screens in the database, quick and advanced. The quick search is similar to a free text search, found in many internet search engines, where the Boolean connector AND is assumed between terms. Phrases must be contained within quotation marks and only indexed fields (authors, publication year, journal title and keywords) are searched. Therefore it is not suitable for searching for references on a particular subject as the keyword coverage is not yet comprehensive.

Advanced search

Advanced search (Fig. 1) is the default screen where you can choose to search in specific fields, including authors, titles and keywords.

To begin an advanced search:

1. Select the *field to search*
2. Enter your *data to locate*
3. Select a *Boolean* operator from the menu
4. Repeat steps 1 to 3 as required
5. Click on the *Start search* button.

Authors' names should be entered as either the last name only or in the format: Werner,F.E. with no spaces between the name and initials. The advanced search assumes wild card searches at the end of two or more characters, thus searching for *fish* would also retrieve *fishes, fisheries* and *fishing*. To combine keywords on the same line use brackets around terms with a Boolean connector e.g. {cod} and {larvae}.

To view the full reference click on the icon to the left of the reference. References may also be marked and selected for export by clicking the check box to the left of the reference.

Please visit the GLOBEC publications webpages and send any amendments or comments to d.ashby@pml.ac.uk.

3rd International Zooplankton Production Symposium

Gijón, Spain, 20-23 May

Sponsored by GLOBEC, PICES and ICES

The International Council for the Exploration of the Seas (ICES), the North Pacific Marine Science Organization (PICES), and the International Global Ocean Ecosystem Dynamics (GLOBEC) program announce a Zooplankton Production Symposium titled *"The Role of Zooplankton in Global Ecosystem Dynamics: Comparative Studies from the World Oceans",* to be held May 20-23, 2003, at the Congress Center in Gijón, Spain.

Sessions will be held on the following topics:

Monday 19 May

Workshop 1: Gelatinous zooplankton and fish: Predators, prey, or nuisance

Workshop 2: Meso- and bathypelagic zooplankton study: Current status and future aspects

Workshop 3: Climate variability, zooplankton abundance and distribution - comparative opportunities from the world's oceans

Workshop 4: Harmonising and synthesising zooplankton time series

Tuesday 20 May

Session 1: Physical variability and zooplankton population dynamics

Session 2: Role of zooplankton in biogeochemical cycles

Wednesday 21 May

Session 3 : Climate influences: What are long-term zooplankton data sets telling us?

Session 4 : New approaches to zooplankton modelling

Session 5 : Progress in molecular biology

Thursday 22 May

Session 1: Physical variability and zooplankton population dynamics (continued)

Session 6: Application of new technologies

Friday 23 May

Session 7: Comparative life histories and life cycles of zooplankton populations within and between the North Pacific and North Atlantic

Session 8: Microzooplankton in the marine pelagial: Recent advances from molecules to ecosystems

Further details can be obtained from the PICES website (www.pices.int) or by contacting the PICES Secretariat, secretariat@pices.int or the GLOBEC IPO, globec@pml.ac.uk.

GLOBEC SCIENCE

A column for scientific notes of relevance to the GLOBEC community

Pelagic foodwebs and sardine in the north Iberian shelf

Antonio Bode[1], Pablo Carrera[2] & Carmela Porteiro[3]
[1]Instituto Español de Oceanografía, Centro Oceanográfico de A Coruña, Spain (antonio.bode@co.ieo.es)
[2]Museo del Mar, Vigo, Spain (pablo.carrera@terra.es)
[3]Instituto Español de Oceanografía, Centro Oceanográfico de Vigo, Spain (carmela.porteiro@vi.ieo.es).

Sardine (*Sardina pilchardus*), a coastal pelagic fish species, is widely distributed in Atlantic and Mediterranean waters, but it mainly concentrates in the southern part of Europe. Shelf waters from the Celtic Sea and the Iberian Peninsula (Fig. 1) support important fisheries mainly composed by artisanal fleets. The associated economical and social relevance of this species stimulated its systematic study from long time ago (Cornide, 1774). In this way, annual landings have been recorded monthly since earlier 1940's around the Atlantic waters of the Iberian Peninsula, and further programs in the 1990's intensified the effort on population structure, stock definition and the estimation of the IberoAtlantic population size and the fate of eggs and recruits (e.g. International Council for the Exploration of the Sea (ICES), 2000).

Recent decreases in both the population size and landings in the north Iberian shelf prompted more detailed studies concerning the relationships between fishes and their environment. On one hand, climatic and large-scale oceanographic changes, along with the stock dynamics, were correlated with changes in the recruitment success of sardine around the Atlantic waters of the Iberian peninsula (Guisande *et al*., 2001; Carrera and Porteiro, 2003; Porteiro *et al*., 2003). On the other hand, several projects included ecological variables, in addition to fish biomass and abundance estimates, in the search for the biological mechanisms responsible for the transmission of changes in the physical environment up to the food web. For instance, two multinational European-funded studies recently focused on topics relevant for the comprehension of the dynamics of pelagic ecosystems around the Iberian Peninsula in relation with sardine. The PELASSES study (99APSC, RP, Contract number 99/010) concentrated on the improvement of observational procedures for estimating both fish population size and relevant properties of their environment, with an emphasis on instrumentalized methods. As a result, maps of sardine abundance during the spawning season, along with oceanographic and plankton variables were obtained at regional scales in spring 2000 and 2001. The study illustrated the heterogeneous distribution of phytoplankton spring blooms in the area, a feature not always evident from averaged satellite-derived information (Fig. 1) but clearly shown by measurements at sea (Fig. 2). Furthermore, the growing database on plankton and oceanographic observations would allow for the identification of interannual changes in the pelagic ecosystem related to climatic variations, as plankton was shown to effectively track water-mass properties in this region (Bode *et al*., 2002). The SARDYN study (QLRT-2001-00818), aims at the construction of a refined model of the sardine population, also includes the measurement of plankton variables that would likely affect sardines. In this way, an intensive effort is being made towards the determination of biomass distribution of plankton organisms that are potential preys of larval and adult sardines.

These studies, along with others supported by the Instituto Español de Oceanografía (IEO), allowed for the consideration of processes affecting the entire pelagic food web, with emphasis in the pathways leading to the sardine and other pelagic fishes. As the adult sardines are omnivorous or opportunistic feeders the study of their food sources is complicated by the large variability of their diets. However, the determination of natural abundance of stable carbon and nitrogen isotopes provided a way to quantify the main exploitation patterns of plankton by sardines. As a first result, the complexity of the pelagic ecosystem in this region appeared higher than initially expected (Bode *et al*., 2003), taking into account that a seasonal upwelling greatly affects productivity in most of the area. Isotopic enrichment with increasing individual size of organisms revealed that enrichment between plankton size-classes was lower than either enrichment between plankton and sardine or enrichment between sardine and the common dolphin,

the latter a top pelagic predator in this ecosystem (Fig. 3a). The obtained log-linear relationship, particularly when considering ^{15}N abundances, opens the possibility for the determination of changes along the food web in response to environmental perturbations, including those from the fishery. Furthermore, a change in the diet of sardines after the first year of life was inferred from the decrease in ^{15}N (and also ^{13}C) abundance in sardines ≥ 18 cm in length (Fig. 3b). Such change implies the increasing consumption of plankton of low trophic position in the food web as sardines grow and their filtering apparatus develops. The reconstructed food web taking into account isotopic signatures included at least three trophic steps between phytoplankton and sardines, while direct consumption of large amounts phytoplankton seemed unlikely (Fig. 4). Such a result was also found in other clupeids from upwelling areas (Monteiro *et al*., 1991). However, differences in ^{13}C and ^{15}N enrichment between plankton and sardine suggest that adult sardines obtain most of their muscle protein from zooplankton while phytoplankton would provide reserve materials. Current studies are considering spatial and temporal variability in both biomass and isotopic composition of plankton and pelagic fish in the northern Iberian shelf. The objective is to quantify changes in food web structure that could be related to the regional oceanography.

Acknowledgements

These studies are a contribution to the GLOBEC-Spain Program, with the support of the IGBP-Spain Committee. PELASSES and SARDYN projects were funded in part by the V Framework Programme of the European Union. Additional funds were provided by projects BIODAS and PELACUS of IEO.

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GLOBEC Data CD

The GLOBEC DATA Product 2002 CD is available free of charge from the GLOBEC IPO (see back page for postal and e-mail details).

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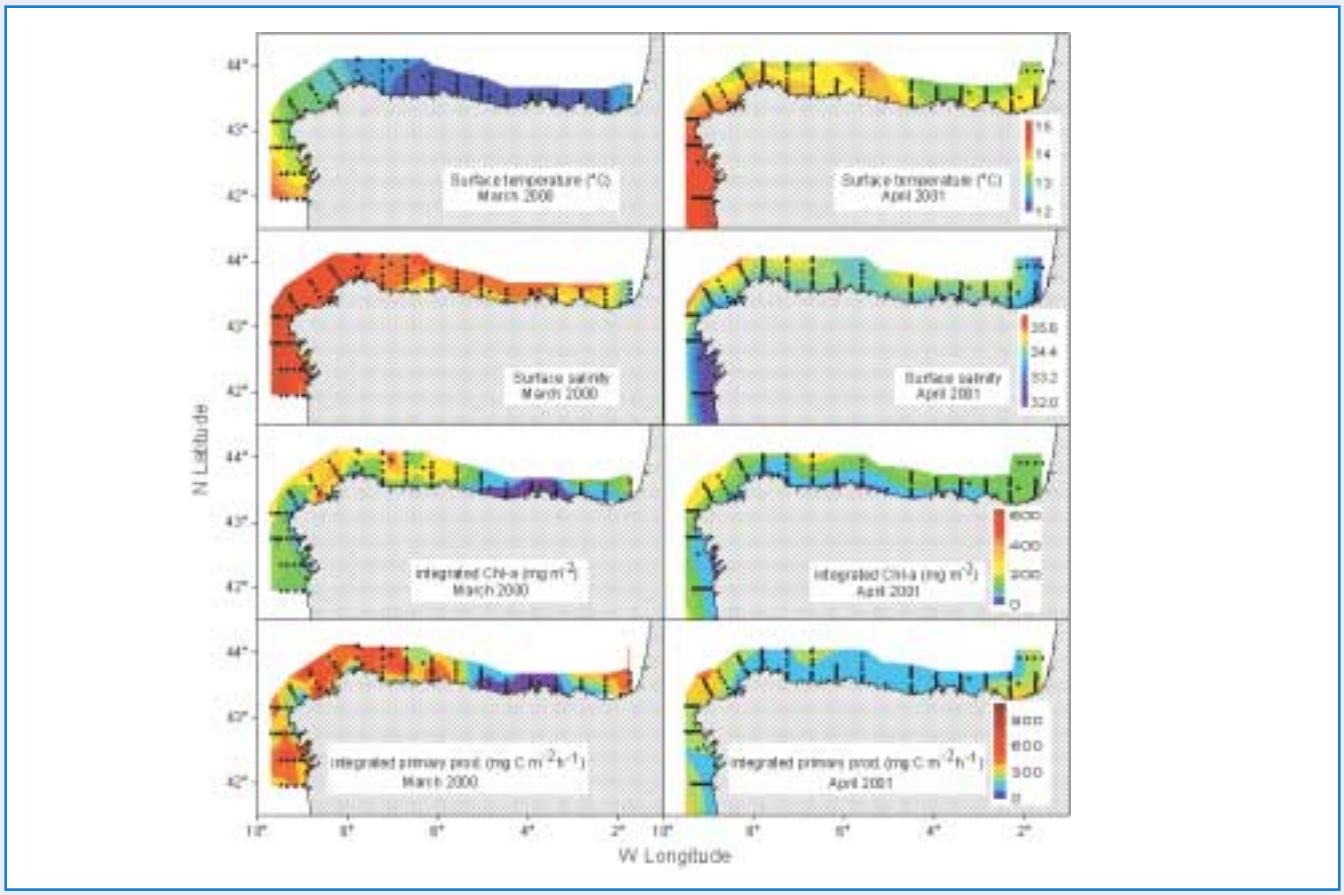

Figure 2. A map of sea surface temperature and salinity, and water-column integrated chlorophyll biomass and primary production measured during spring cruises in the northern Iberian shelf.

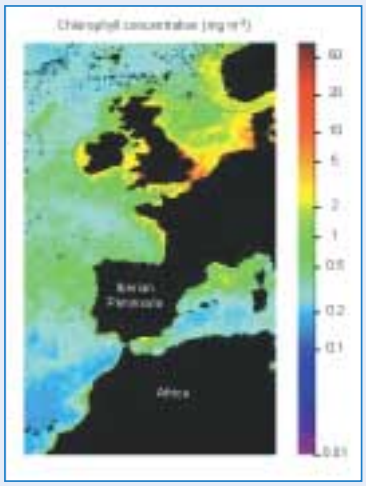

Figure 1. SeaWiFs-derived surface chlorophyll concentration averaged between 21 March and 21 April 2000 in waters around the Iberian Peninsula. Image courtesy of SeaWiFs Project (NASA).

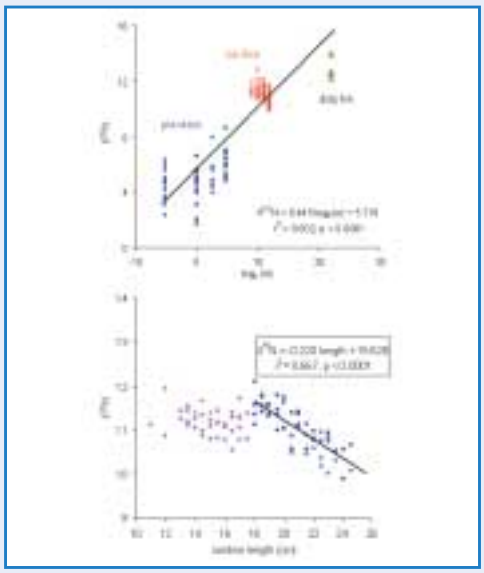

Figure 3. Variation of natural abundance of ^{15}N with (a) the individual size of plankton (four size-classes from 20 to 2000 mm), sardines and common dolphin, and (b) the size of sardines off Galicia (NW Spain) in March 1999. Regression lines for the overall relationship (a) and for sardines ≥ 18 cm (b) were shown.

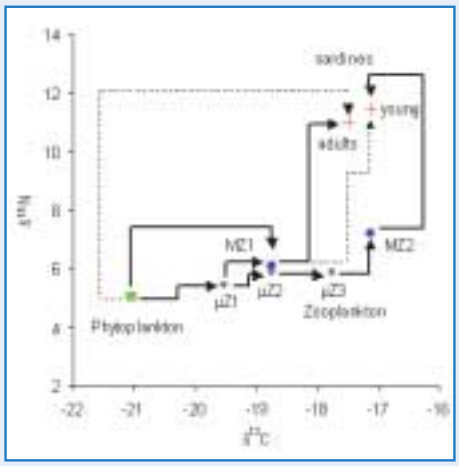

Figure 4. Reconstruction of trophic pathways linking plankton and sardine components in the northern Iberian shelf ecosystem from ^{13}C and ^{15}N abundance values. Each component is located according to average values of isotopic abundance. Thick arrows indicate the most probable links while dashed arrows indicate less probable links.

Chinese satellite ocean color remote sensing in 2002

Pan Delu
Key Lab of Ocean Dynamic Processes and Satellite Oceanography of State Oceanic Administration, Hangzhou, P.R. China (pandelu@mail.hz.zj.cn)

Ocean color satellite HY-1

The special ocean color satellite HY-1 was launched to altitude of 870km together with FY-1D satellite in May 2002. HY-1 is a small satellite with a mass of approximately 350kg and three-axis stabilized. The working life is designed about 2 years. In order to get a short repeat period, orbit shift will be made and finally the satellite will move and operate in a near sun-synchronous and near-polar orbit at altitude of 798km. The satellite body is constructed by the Chinese Academy of Space Technology (CAST), and is composed of the communication and data transmission subsystem, the electrical power subsystem and the attitude and orbital control subsystem. On the satellite there are two sensors, one is the Ocean Color and Temperature Scanner (COCTS), the other is CCD Coastal Zone Imager (CZI). COCTS and CZI will be designed and manufactured respectively by Shanghai Institute of Technical Physics of Chinese Academy of Sciences and Chinese Academy of Space Technology respectively.

The COCTS is an optical radiometer to detect ocean color and surface temperature. The characteristic is similar to the SeaWiFS on SeaStar and OCTS on ADEOS-1. COCTS has functions to detect the amount of chlorophyll and dissolved substances in the water, and temperature distribution. The data of COCTS will be used to get the information of ocean conditions for fishery and environment monitoring. Its repeat period is 3 days. There are 8-channel visible and near-infrared bands and 2-channel thermal infrared bands with the spatial resolution of 1.1km. The CZI is a medium spatial resolution optical sensor for observing ocean color, land and coastal zones. CZI has 4 spectral bands from 0.42 to 0.89μm with spatial resolution of 250m. The CZI data will be used for regional mapping of different water constituents and vegetation, monitoring pollution of coastal zones for resource exploration etc. Its repeat period is 7 days. Some reasonable images have been mapped by COCTS and CZI, such as chlorophyll, suspended material and temperature (Fig. 1 - back page).

Development of more advanced sensor for next generation satellite

The most areas of China Sea belong to case 2 water, the algorithm based on ratio of green to blue is not suitable to those areas because two or more substances with different optical properties are presented which do not co-vary with chlorophyll a concentration. These might be waters with exceptional plankton blooms (such as red tides), the water of areas discolor by retained and organic suspended materials and DOM, such as acids. It is, therefore, essential to develop more channels with more sensitive sensors for Chinese coastal water detection. One sensor has been developed and tested on the spaceship Shen Zhou-3 (SZ-3), is termed as Chinese Moderate Imaging Spectra Radiometer (CMODIS) manufactured by SIPT. There are total 34 channels, 30 channels of 20nm wavelength in the spectra range of 0.403~1.043μm, and four infrared channels with 2.15~2.25μm, 8.4~8.5μm, 10.3~11.3μm and 11.5~12.5μm, instant field of view with 1.2m, 1024 pixels per one line, quantification of 12 bits. The CMODIS has been installed in the spaceship SZ-3 which was launched in March, 2002. The orbit of SZ-3 is non-sun-synchronous and the coverage of CMODIS in China is shown in Figure 2. The quite good imageries show the high sensitivity. With the preliminary analysis of prototype data from the SZ-3, it is realized that the data can be used in inverse modeling to extract the chlorophyll and suspended material (Fig. 2 - back page) and also show the great potential to monitor the coast water environment. The CMODIS will be a good candidate of the new generation of environmental satellites of China.

Plan for ocean color in next ten years

The HY-1 satellite series is planned by Chinese Government, which includes four satellites, HY-1A in 2002, HY-1B in 2004, HY-1C in 2006 and HY-1D in 2008. This series designed to measure the ocean color and temperature environment by the visible and infrared sensor, such as COCTS and high spectra resolution scanner. The main purpose of series HY-1 is to detect the marine environmental parameters of the China Sea, including chlorophyll concentration, suspended sediment concentration, dissolved organic matter, pollutants, as well as sea surface temperature. The satellite will play an important role in developing and utilizing the marine bio-resources, constructing and managing harbours, detecting ocean pollution, investigating and developing coastal resources and studying the regional dynamic and global environmental changes.

GLOBEC CALENDAR

2003

13-16 April: LOV/IOC/NSF/NOAA Workshop on Regime Shifts. Villefranche-sur-mer, France

5-8 May: 3rd JGOFS Open Science Meeting – A Sea of Change: JGOFS accomplishments and the Future of Ocean Biogeochemistry. Washington D.C., USA

5-7 May: GLOBEC-ICES CCC Synthesis Workshop. New Bedford, USA

7-9 May: ICES/GLOBEC CCC Working Group Meeting. New Bedford, USA

20-23 May: GLOBEC-PICES-ICES Zooplankton Production Symposium. Gijón, Spain

24 May: GLOBEC Focus 2 WG Meeting. Gijón, Spain

26-28 May: 1st Planning Meeting of the GLOBEC regional activity on Ecosystem Studies of SubArctic Seas (ESSAS). Bergen, Norway

30 May – 2 June: SCOR/IOC Study Group on 'Extending Ecosystem models to the basin scale'. Cambridge, UK

18, 19 and 24 June: GLOBEC SSC Meeting. Banff, Canada

19-24 June: IGBP Congress. Banff, Canada

25-26 June: GLOBEC Focus 4 Working Group Meeting. Canada

3-4 July: Marine Productivity (UK-GLOBEC) Science Meeting. Edinburgh, Scotland

15-19 September: SCOR Executive Committee. Moscow, Russia

15-19 September: GAIM and WGCM (WCRP) – 'International Conference on Earth System Modelling'. Hamburg, Germany

24-27 September: ICES ASC. Tallin, Estonia

16-18 October 2003: IHDP Open Science Meeting. Montreal, Canada

October: 2nd Planning Meeting of the GLOBEC regional activity on Ecosystem Studies of SubArctic Seas (ESAS). Seattle, USA

4-7 November: GLOBEC-CLIOTOP (Large Pelagics). Sete, France

10-18 November: PICES XI. Seoul, Korea

1-4 December 2003: Open Science Conference 'Global Change and the Terrestrial Human-Environment System'. Morelia, Mexico

December 2003: SPACC Workshop on Long-Term Dynamics of Small Pelagic Fish and Zooplankton in Japanese Waters. Tokyo, Japan

2004

February: UK-GLOBEC Open Science Meeting. London, UK

31 March – 3 April: IOC-SCOR-GLOBEC Symposium on 'Quantitative Ecosystem Indicators for Fisheries Management'. Paris, France

2-6 May: 4th World Fisheries Congress, Reconciling fisheries with conservation: the challenges of managing aquatic ecosystems. Vancouver, Canada

11-14 May: ICES-GLOBEC Symposium on 'The Influence of Climate Change on North Atlantic Fish Stocks'. Bergen, Norway

21-25 June: CLIVAR 2004: 1st International CLIVAR Science Conference. Baltimore, USA

New GLOBEC Publications 2002

GLOBEC Report 15. Report of a GLOBEC-SPACC/APN Workshop on the Causes and Consequences of Climate-induced Changes in Pelagic Fish Productivity in East Asia. 25-27 August 2001, Kobe, Japan.

GLOBEC Report 16. Report of a GLOBEC-SPACC/IDYLE/ENVIFISH Workshop on Spatial Approaches to the Dynamics of Coastal Pelagic Resources and their Environment in Upwelling Areas. 6-8 September 2001, Cape Town, South Africa

GLOBEC Report 17. Report of Optical Plankton Counter Workshop 17-20 June 2001, Tromsø, Norway.

GLOBEC Special Contribution 5. Report of the first meeting of the SPACC/IOC Study Group on "Use of environmental indices in the management of pelagic fish populations" (3-5 September 2001, Cape Town, South Africa)

Barange, M. 2002. Influence of climate variability and change on the structure, dynamics and exploitation of marine ecosystems. In: R.E. Hester and M. Harrison (Eds.), Global Environmental Change, Issues in Environmental Science and Technology 17: 57-82.

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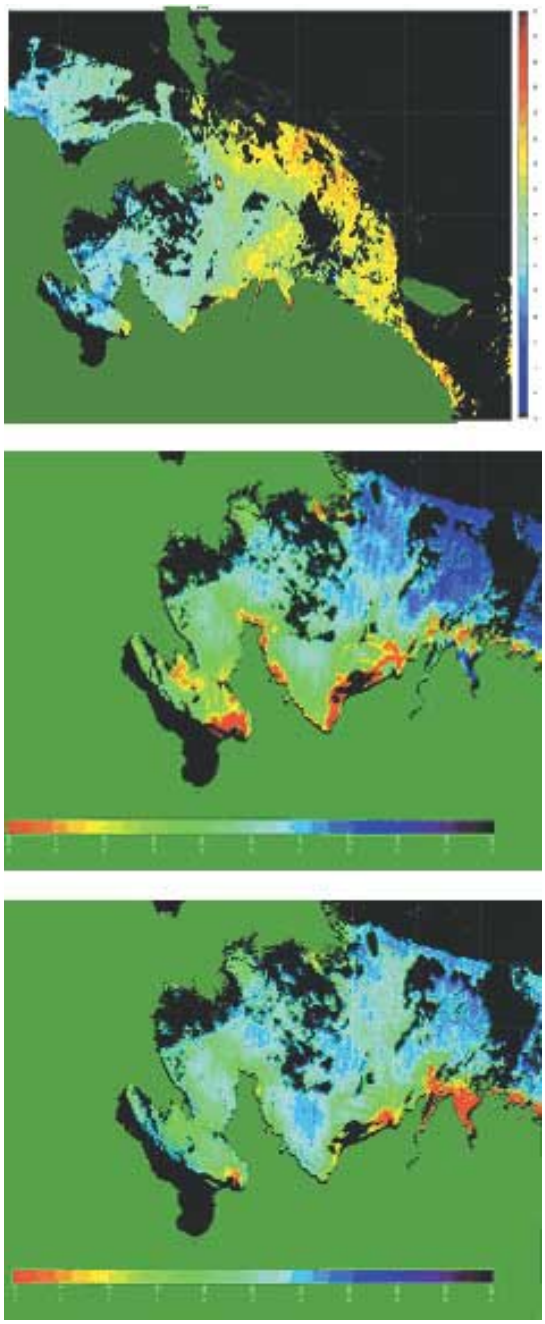
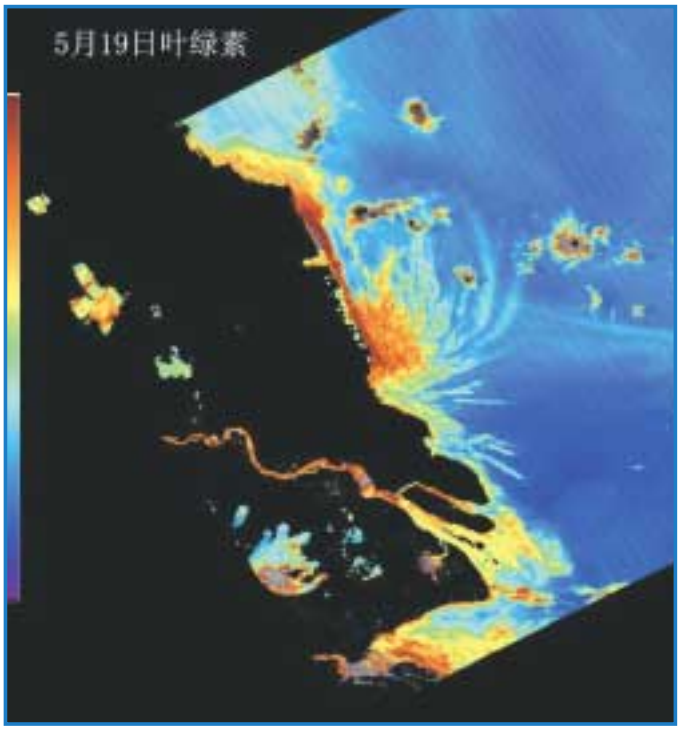
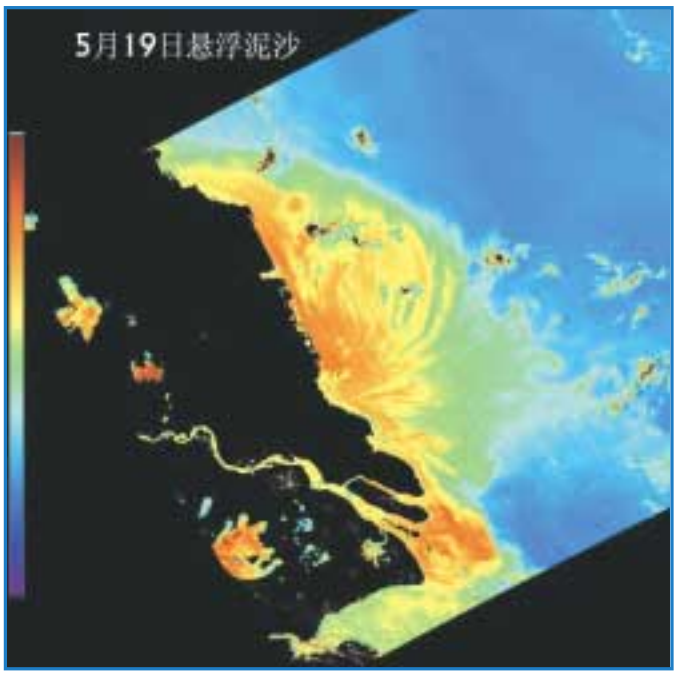


Delu (p.30) - Figure 1. The images are mapped from COCTS data, (a) chlorophyll concentration, (b) suspended material and (c) temperature.





Delu (p.30) - Figure 2. The images are mapped by CMODIS, (a) chlorophyll and (b) suspended material.

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