

U.S. GLOBEC NEWS

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Recent Developments in International GLOBEC

by Roger Harris

GLOBEC adopted by IGBP as Core Project

The overall objective of the International Geosphere-Biosphere Program (IGBP) is:

“To describe and understand the interactive physical, chemical and biological processes that regulate the total Earth system, the unique environment that it provides for life, the changes that are occurring in this system, and the manner in which they are influenced by human activities”

During the IGBP meeting held in Beijing in October 1995, the GLOBEC Science Plan was presented to and approved by the SC-IGBP as a contribution to this objective. GLOBEC is thus accepted as a new IGBP Core Project, with co-sponsorship by the Scientific Committee on Oceanic Research (SCOR) and the Intergovernmental Oceanographic Commission (IOC).

The adoption of GLOBEC as a Core Project of the International Geosphere-Biosphere Program is a significant landmark in the development of the international program. GLOBEC has come a long way since the first international GLOBEC planning meeting in Ravello in 1992 attended by David Cushing, Bob Dickson, John Field, Liz Gross, Tom Osborn, Brian Rothschild, Mike Sissenwine, Victor Smetacek, Jarl-Ove Stromberg, Takashige Sugimoto, Qisheng Tang, Phil Taylor and Dr A DeMaio.

IGBP Congress

GLOBEC was represented at the first IGBP Congress held in the small medieval town of Bad Münstereifel in Germany from 17 to 23 April, 1996. This was the first time in the ten year history of the IGBP that all the Program Elements had met together. The Core Projects and Framework Activities represented were:

BAHC	Biospheric Aspects of the Hydrological Cycle
IGBP-DIS	IGBP Data and Information System
GAIM	Global Analysis, Interpretation and Modeling
GCTE	Global Change and Terrestrial Ecosystems
GLOBEC	Global Ocean Ecosystem Dynamics
IGAC	International Global Atmospheric Chemistry Project
JGOFS	Joint Global Ocean Flux Study
LOICZ	Land Ocean Interactions in the Coastal Zone
LUC	Land Use/Cover Change
PAGES	Past Global Changes
START	Global Change System for Analysis, Research and Training

On the first and last full days of the Congress the Program Element SSCs held their business meetings (with the exception of GLOBEC, whose SSC was still in the process

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of formation). These included special emphasis on inter-Program Element collaboration, and significant progress was made in terms of planning and specific agreements. The second full day was devoted to presentations from the Chairs of the of the eleven IGBP Program Elements (including GLOBEC) in which recent successes and future plans were reviewed. A particular question after the GLOBEC presentation concerned the apparent northern hemisphere focus of the project; developing GLOBEC in the southern hemisphere is an important issue which clearly needs addressing. The following two days covered a wide variety of theme sessions and discussion topics, “Ice and Earth System Variability”, “Ecological Buffering in Global Change”, “Modeling the Total Earth System”, “Global Change and Food Supplies”, “Capacity Building” and “Closing the Carbon and Nitrogen Cycles” being just a few examples to give a flavor of the

The venue of the Congress was the Bad Münstereifel Kurhaus, an old monastery which was renovated and converted relatively recently. This setting provided an excellent environment for both individual and group interactions and discussions. The Congress was very efficiently organized by the IGBP Secretariat, especially by the Deputy Executive Director, Neil Swanberg, who is well known in the marine science community. Another familiar face at the Congress was that of Liz Gross, Executive Director of SCOR, who represented a variety of oceanic research interests.

Scientific Steering Committee Changes

The adoption of GLOBEC by IGBP has provided the opportunity to make some changes in the composition of the

The current membership of the International GLOBEC SSC:

Dag Aksnes	Dept. of Fisheries and Marine Biology, University of Bergen, Norway
Jürgen Alheit	Baltic Sea Research Institute, University of Rostock, Germany
Tommy Dickey	University of California, Santa Barbara, USA
Roger Harris	Plymouth Marine Laboratory, UK (Chairman)
Eileen Hofmann	Old Dominion University, USA
Tsutomu Ikeda	Faculty of Fisheries, Hokkaido University, Japan
Ian Perry	Pacific Biological Station, DFO, Nanaimo, Canada
Brian Rothschild	University of Massachusetts, Dartmouth, USA
Jarl-Ove Stromberg	Kristineberg Marine Research Station, Sweden
Svein Sundby	Institute for Marine Research, Bergen, Norway
Qisheng Tang	Yellow Sea Fisheries Research Institute, Qingdao, China

Congress discussions. These discussions were lively and productive. A specific session addressed the topic of “IGBP Oceans Research”, and clearly a challenge for the GLOBEC community will be to establish effective integration and links with the other two marine Program Elements (JGOFS and LOICZ). However, an even more stimulating challenge will be to view GLOBEC research in the wider context of the IGBP, and to look to developing good interactions with relevant terrestrial projects, making comparisons between terrestrial and marine ecosystems. For example there is potential for linking, through theoretical and modeling work, with the initiative of GCTE on “Global Change and Ecological Complexity”. The wider IGBP context also challenges GLOBEC to bear in mind the human dimension, for example aspects of food supply (the significance of fisheries), and also the important issues of training and capacity building.

SSC. Both SCOR and IGBP rules call for a rotation of the Chairs and members of their committees every three years; this mechanism ensures that there is an opportunity for new people to become involved. The composition of the GLOBEC SSC strives for balanced disciplinary and international representation while at the same time maintaining important continuity with the membership of the original committee. The current members are listed below, and nominations are currently being considered to expand membership from the southern hemisphere.

The SSC is responsible for overseeing the development and implementation of the GLOBEC program in accordance with the published Science Plan. The SSC will develop a detailed Implementation Plan for GLOBEC for presentation to the

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sponsoring organizations and the larger scientific community; and it will recommend to the sponsoring organizations the necessary action to be taken in accordance with the GLOBEC Science and Implementation Plans and will coordinate and manage the resulting activities. The Steering Committee will collaborate, as appropriate, with other global change programs and planning activities, such as JGOFS, LOICZ, WCRP, the IOC/FAO program on Ocean Science and Living Resources, and the emerging Global Ocean Observing System, GOOS. Appropriate data management policies will be established to ensure sharing and preservation of the GLOBEC data set. The SSC will report regularly to SCOR, IGBP and IOC on the state of planning and accomplishment of GLOBEC.

SSC Meeting

The new GLOBEC Scientific Steering Committee held its first meeting at the Johns Hopkins University from 11-13 November 1996, together with representatives of national and regional GLOBEC programs, and invited specialists (See photo). The meeting began by considering the Science Plan, and then moved to a review of the status of the major GLOBEC field programs. Keith Brander and Svein Sundby presented the ICES Cod and Climate Change Program, Ian

Perry the PICES Climate Change and Carrying Capacity Program, Jürgen Alheit and John Hunter the Small Pelagics and Climate Change Program, and finally Eileen Hofmann reviewed Southern Ocean GLOBEC. After this, discussion moved to the four major research foci of GLOBEC. Alan Robinson and Tommy Dickey, respectively, reviewed the work of the Numerical Modelling, and Sampling and Observation Systems, Working Groups. John Hunter and Brian Rothschild then followed by leading discussion of initiatives in Retrospective Data Analysis, and Process Studies.

A major objective of the Baltimore SSC meeting was to strengthen communication and links with the active national and regional GLOBEC programs. A special session of presentations reviewed the impressive range of established research activities and plans within these programs. Tom Powell presented the U.S. GLOBEC program, Brad de Young spoke about GLOBEC Canada, Qisheng Tang reviewed China GLOBEC, Tom Ikeda Japan GLOBEC, Svein Sundby reported on Norway and Mare Cognitum and Keith Brander provided a report on UKGLOBEC planning. There was also discussion of developments in other countries, for example, Germany and France, Korea, Russia, the ICES countries, South Africa, Chile and New Zealand.

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GLOBEC SCIENTIFIC STEERING COMMITTEE MEETING: The John's Hopkins University, Baltimore, 11-13 November 1996—Left to right: Dag Aksnes, Eileen Hofmann, Jarl-Ove Stromberg, Ian Perry, Tom Powell, Svein Sundby, Tommy Dickey, Brian J. Rothschild, Jurgen Alheit, Brad de Young, Roger Harris, Ole Henrik Haslund, John Hunter, Qisheng Tang, Allan Robinson, Keith Brander, Neil Swanberg, Tsutomu Ikeda, Elizabeth Gross.

Other issues considered by the SSC included relations between GLOBEC and Global Change System for Analysis, Research and Training (START) on which a presentation was given by Hassan Virji, plans for developing an Implementation Plan and an Open Science Meeting (see below), and various aspects of GLOBEC communication, for example publication of GLOBEC reports (see below), the GLOBEC Newsletter and web-site.

The GLOBEC Science Plan

The GLOBEC Science Plan will shortly be published by IGBP. The GLOBEC Science Plan has benefited from the careful drafting by the SCOR/IGBP Core Project Planning Committee. It has been based on a draft plan written by the SCOR/IOC SSC for GLOBEC in 1994. That plan was itself based on a number of scientific reports generated by the successful series GLOBEC working groups, and on discussions at the GLOBEC Strategic Planning Conference (Paris, July 1994). The members of the SCOR/IGBP CPPC were Brian Rothschild (Chair), Robert Muensch (Chief Editor), John Field, Berrien Moore, John Steele, Jarl-Ove Stromberg and Takashige Sugimoto.

At the beginning of the Science Plan, the GLOBEC Goal is stated:

To advance our understanding of the structure and functioning of the global ocean ecosystem, its major subsystems, and its response to physical forcing so that a capability can be developed to forecast the responses of the marine ecosystem to global change.

Consideration of how best to achieve this goal has led directly to the development of four primary GLOBEC objectives (see box, this page).

Development of an Implementation Plan and the first Open Science Meeting

The publication of the GLOBEC Science Plan provides a strong foundation for moving to implementation. This is the critical issue facing the members of the new GLOBEC SSC who will develop a detailed Implementation Plan, during 1997, for presentation to the sponsoring organizations and the larger scientific community. An Open Science Meeting will be held 17-20 March 1998 at the Intergovernmental Oceanographic Commission of UNESCO in Paris. This first Open Science Meeting of GLOBEC will serve to present the draft Implementation Plan to the international science community and provide a forum for its discussion and feedback (see announcement, page 5).

The four objectives of the Science Plan lead to a specific set of research foci, which describe the scientific approach, and will be developed in the Implementation Plan. These program foci are as follows:

Focus 1: Build a foundation for future global ecosystem models through re-examination of historical data bases.

Focus 2: Conduct process studies organized around the themes of (1) research and modeling of ecosystems and trophodynamics, (2) identification and understanding of mesoscale physical-biological interactions and (3) research on forced responses in ecosystems.

Focus 3: Develop predictive and modeling capabilities with interdisciplinary, coupled modeling-observational systems.

Focus 4: Cooperate with other ocean, atmosphere, terrestrial and social global change research efforts to estimate feedbacks from changes in marine ecosystem structure to the global earth system.

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OBJECTIVE 1	To better understand how multiscale physical environmental processes force large-scale changes in marine ecosystems
OBJECTIVE 2	To determine the relationships between structure and dynamics in a variety of oceanic systems which typify significant components of the global ocean ecosystem, with emphasis on trophodynamic pathways, their variability and the role of nutrition quality in the food web.
OBJECTIVE 3	To determine the impacts of global change on stock dynamics using coupled physical, biological and chemical models linked to appropriate observation systems and to develop the capability to predict future impacts.
OBJECTIVE 4	To determine how changing marine ecosystems will affect the global earth system by identifying and quantifying feedback mechanisms.

GLOBEC Open Science Meeting

Paris, 17-20 March 1998

Background

GLOBEC (Global Ocean Ecosystem Dynamics) was adopted in 1995 by IGBP as a new Core Project, with co-sponsorship from SCOR and IOC. Its goal is to advance our understanding of the structure and functioning of the global ocean ecosystem, its major subsystems, and its response to physical forcing so that a capability can be developed to forecast the responses of the marine ecosystem to global change. Objectives and research foci of GLOBEC are laid down in the Science Plan which will shortly be published.

Scope

During 1997, the Scientific Steering Committee of GLOBEC, in collaboration with GLOBEC key researchers, will develop an Implementation Plan for GLOBEC. The First Open Science Meeting of GLOBEC will serve to present a draft of this Implementation Plan to the international science community and provide a forum for its discussion, and for feedback.

Structure

The Meeting will feature invited plenary key note presentations on GLOBEC, its major subprojects and their implementation. In parallel sessions, additional invited contributions in smaller groups will address specific topics such as regional GLOBEC initiatives, relationships with other IGBP Core Projects (e.g. JGOFS, LOICZ, PAGES) and other programmes such as WCRP (WOCE, CLIVAR), GOOS, the Large Marine Ecosystems Project (LME) and the International Human Dimension Programme (IHDP). GLOBEC researchers are encouraged to display contributed

posters on concepts, results and conclusions of their own research. One session will be devoted to training, education and capacity building within GLOBEC.

Organisation

The Meeting is open to any individual scientist interested in GLOBEC. It is organised by the Scientific Steering Committee of GLOBEC with the joint co-sponsorship of IGBP, the Scientific Committee on Oceanic Research (SCOR) and the Intergovernmental Oceanographic Commission (IOC). Support for a limited number of scientists from developing countries may be available.

Organising Committee

Professor Dag Aksnes (Norway), Dr Jürgen Alheit (Germany), Dr Roger Harris (United Kingdom), Dr Tsumoto Ikeda (Japan), Dr Ian Perry (Canada), and Dr Qisheng Tang (China).

Date and Venue

The GLOBEC Open Science Meeting will be held 17-20 March 1998 at the Intergovernmental Oceanographic Commission of Unesco, Paris, France.

Further Information

Chairman of the GLOBEC Scientific Steering Committee: Dr. Roger Harris, Plymouth Marine Laboratory, Prospect Place, Plymouth PL1 3DH, England. Tel: +44-1752-633 400, Fax: +44-1752-633 101, e-mail: r.harris@pml.ac.uk

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Developments in GLOBEC—(Cont. from page 4)

The Major Components of GLOBEC

The GLOBEC Core Program consists of a series of activities, planned under the aegis of the GLOBEC SSC. Much of the foundation has been laid at a series of planning meetings, in particular the 1993 GLOBEC Working Group on Population Dynamics and Physical Variability (GLOBEC Report No, 2) ; other working groups are directing GLOBEC efforts in, for example Numerical Modeling (GLOBEC Report No, 6) and Sampling and Observation Systems (GLOBEC Report No, 3).

In addition, the GLOBEC Core Programme has a major field

study component. The four largest field research programmes are briefly described below. Much more detailed planning documents are available for each of them.

The first two field studies - Southern Ocean GLOBEC and the study on Small Pelagic Fishes and Climate Change - are the responsibility of two GLOBEC working groups (see GLOBEC Reports Nos.5 and 8) and therefore, fall directly under the oversight of the GLOBEC SSC. In the case of the former, the extent of the Southern Ocean region, the number of countries involved and the enormous logistical difficulties encountered in any major oceanographic effort there, make full international co-ordination essential. The SPACC

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The TASC Annual Meeting, 8-11 January 1997

by Charlie Miller

The second trans-Atlantic gathering of the faithful friends of *Calanus finmarchicus* was held in crisp, cool winter weather at the Dansk FolkFerie in Gileleje, Denmark, a fishing village at the north tip of Zeeland. FolkFerie was translated for us as “holiday center”, and it appears the Danes have some good ideas about holidays. We occupied pleasant, spacious cabins and were fed gourmet food in a convivial dining hall. The view from the bluff near our meeting room was of the Kaategaat, and it was possible to imagine Petersen and Hensen sampling just at the horizon. The local arrangements for this “TASC-II” meeting were made by Keith Brander, our hero at ICES, and Katherine Richardson of Danish Sea Fisheries. Many of the communications and arrangements for equipment and transport were made by Tone Falkenhaus and Kurt Tande, and we attendees thank all of you cordially.

Our purpose at Gileleje was to review the progress of and plans for TASC studies as the European program hits full pace early this winter. We particularly wanted to compare European and North American studies. This was with an eye to insuring that, as our work progresses, we will get good data for valid comparisons from all along the range of *C. finmarchicus*. In fact, we identified a major gap, that we will not have much sampling from the great central region to the SW of Iceland, a population center for *C. finmarchicus* in which life history timing appears to be distinctive. Life history studies of this dominant, boreal copepod are clearly the unifying theme of TASC work, and many aspects of its phenology were presented at TASC-II. Much of the best work was presented by young scientists, and it was a pleasure to see the future of zooplankton studies in the North Atlantic region in such promising hands. There were many examples. Barbara Niehoff (who

works with Han-Jürgen Hirche) gave her first professional talk in English without missing a beat. She presented fine data about egg production in mesocosms. Her poster presented a detailed study of the developmental sequence of egg clutches in the oviduct of *Calanus*. It was a small and fruitful intrusion of real biology (cells, nuclei, ducts) into an ecological session almost devoid of such basics. Perhaps we can learn more ecology by being more biological at times.

Benjamin Planque presented a fine new analysis of continuous plankton recorder data. Evidently, *C. finmarchicus* has distinct seasonality of its active development phase in three major subregions of the North Atlantic: in the far west the stock comes out of diapause very early, December-

Much of the best work was presented by young scientists, and it was a pleasure to see the future of zooplankton studies in the North Atlantic region in such promising hands. There were many examples.

January, and subsequent generations are actively developing through late spring; in the Norwegian Sea and adjacent areas arousal peaks in mid-March, and the population is active well into summer; finally, in the middle region south of Greenland, arousal is even a little later (end of March) and active development is in progress into early autumn. All of the data presented from TASC studies agreed with this strong difference in life cycle timing across the range. For example, data presented by Erica Head from the eastern side of the Labrador Sea hinted at this distinctive timing, even distinctive development characteristics of this

central substock. Planque also showed (see Fromentin and Planque, 1996, MEPS 134:111) that the stock of *C. finmarchicus* in the eastern Atlantic varies in detailed parallel with the strength of the North Atlantic oscillation (NAO). This measure of atmospheric pressure difference has dropped on average over the past three decades, and CPR abundance measures for *C. finmarchicus* dropped over the same interval by approximately 40%.

Two precise growth rate studies were presented by Robert Campbell and by Bengt Hygum and Catherine Rey which will provide much improved parameterization of *Calanus numericus* (introduced to science at the meeting by François Carlotti). Camilla Svensen (represented by Kurt Tande) showed experimental results implying that sex determination in *C. finmarchicus* is under partial environmental control. Heather Madden reminded us that *C. finmarchicus* almost always lives sympatrically with other *Calanus* species, and Thomas Torgerson reminded us that *C. finmarchicus* can fall victim to parasites and disease. Espen Bagoien, Trine Dale and Kjetil Eiane compared several fjords to show how predation may modify the vertical levels chosen by resting stages of *C. finmarchicus*. They made evident the power of interfjord comparisons to reveal aspects of marine plankton biology. Andy Bryant, Oyvind Fiksen, Alisdair, Ole-Petter Pedersen and Eddie McKenzie all showed insight-generating modelling results. Tone Falkenhaus showed the power of recurring anatomical evaluation to reveal seasonal patterns in reproduction and activity level. Melissa Wagner’s poster showed an application of RNA/DNA ratios to evaluation of growth status.

Many older hands were also present at

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TASC—(Cont. from page 6)

Gileje, of course, and they also showed good signs of recent activity. However, those are not so exciting to report in detail, and summaries can be found in the abstract series for the TASC annual meeting at the TASC web site (<http://calanus.nfh.uit.no/TASC.HTML>).

The premiere goal of GLOBEC projects like the Georges Bank study and Euro-TASC is to show the couplings between physical processes in the sea (from general circulation to microturbulence) and the ecology of marine zooplankton. Success in reaching this goal was evident at TASC-II from studies on both sides of the Atlantic. In the Georges Bank area we are now able to explain the localization of cod spawning sites by coupling regional patterns of flow to the life history of *C. finmarchicus*. This understanding is embodied in models generated by Dan Lynch's group (results discussed at TASC-II by Peter Wiebe) that treat animals as Lagrangian objects moving in flow fields generated by fundamentally Eulerian physical models, and it is well verified in Ted Durbin's sampling results from the Georges Bank Broad Scale Survey.

A very similar approach has resulted from a collaboration between groups headed by Jan Backhaus and Mike Heath. Their simulations show the importance of deep circulation to stocking the region southwest of the Faeroes-Iceland ridge with resting stage *Calanus*, and thus to the strength of the spring eruption of the stock. Heath and Katherine Richardson are strong advocates of the notion that the abundance of resting stocks south of the ridge determines abundance there and in the northern North Sea during the subsequent generation developing in spring. The Backhaus-Heath consortium argued convincingly that variation in deep flow from the Norwegian Sea should parallel the NAO, and that the Norwegian Sea is

the source of a large fraction of deep resting stocks south of the ridge. Therefore, they think variation in seed stock numbers is the principal explanation of the NAO-*C. finmarchicus* correlation seen by Planque and coworkers in northern reaches of the CPR study. Extended testing of these notions is part of Euro-TASC's work for the next two years, and a start was shown by Dagmar Hainbucher on field testing of physical aspects of the hypothesis.

Most of our field data are still to come, of course, but an awkward moment was produced by an apparent contradiction between multiple opening-closing net data from Astthor Gislason and Olafur Astthorsson and OPC data from Heath and Richardson at nearly the same site and date. The Icelandic team found large numbers of resting *Calanus* in a layer where the UK-Danish team found none. Fortunately, the UK sampler includes profiles of preserved plankton, and a resolution will surely emerge. Odd how productive a disagreement can be. Exciting time series will be generated by Euro-TASC. One is a study by Stig Skreslet in the coastal zone off central Norway. Another is the Faeroes time series in progress under the direction of Eilif Gaard. Another is the more oceanic time series at Station M to be gathered by a cooperative effort including Hans-Jürgen Hirche, Roger Harris and others. The meeting gave them a chance to sit together and plan.

Modelling of ecological aspects of *C. finmarchicus* biology is a central activity of TASC, which was reviewed by Dag Slagstad. Convergence of *C. numericus* Carlotti, 1997 with *Calanus finmarchicus* (Gunnerus, 1770) was evident in many talks and posters at TASC-II. We have very good egg production measures, like those of Jeff Runge, Katherine Richardson, Hans-Jurgen Hirche and Barbara Niehoff, and François Carlotti has modelled a reasonable physiology to explain their variation. Growth rates and develop-

ment rates as a function of temperature at full nutrition have been very well measured in the past year, and some studies of nutritional effects are in progress. More modelling of 'reasonable internal processes' in this fashion was promised by Brad DeYoung and Geoff Evans of Canada GLOBEC. The roles of stored and active lipids are becoming evident in work like that of Sigrun Jonasdottir and can be included in individual-based models incorporating physiology. A little progress was evident on understanding life history decision points: to rest or mature, to arouse from rest or not, to be male or female. However, the real physiological controls of these decisions will probably evade us for the present round of TASC because (1) we do not have a sufficiently physiological orientation and (2) because the outcomes of decisions in laboratory containers are so evidently different from those in the field despite our best efforts to make our animals feel at home. Our examination of genetics, principally by Ann Bucklin to date, will show the degree to which *C. finmarchicus* is one adaptive system suited to circumstances throughout the range or has subregional specializations. Genes for general metabolic enzymes have shown mostly homogeneity. A search for genes controlling specific life history decision processes may or may not show this widespread similarity. The outcome will be important to validating models of population transport and exchange. Ann presented an argument based on her gene sequence data suggesting that the *C. finmarchicus* population passed through a very narrow population bottleneck in the geologically recent past, probably due to restriction to a very much smaller range in the last ice age. This certainly won first place among intellectual tours-de-force at TASC-II, and most of us will understand it only when we have a chance to study the details.

A glaring weak point in models to date is the huge freedom allowed in assign-

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U.S. GLOBEC Calendar

1997

2-7 March: Gordon Research Conference on Sea Ice Ecology, Ventura, California, USA. Contact: Stephen F. Ackley, Chairman GRC on Sea Ice Ecology Cold Regions Res. and Engr. Lab., 72 Lyme Rd., Hanover, NH 03755 USA. (FAX: 603-646-4644; Internet: sackley@crrel.usace.army.mil; Website: <http://www.grc.uri.edu/progra~1/seaiice.htm>)

19-21 March: ICES Symposium on "The temporal variability of Plankton and Their Physico-Chemical Environment", Kiel, Germany. Contact: ICES Secretariat, ICES, Palagade2-4, DK-1261 Copenhagen K, Denmark (Phone: +45-33-154-225; FAX: +45-33-934-215; Internet: ices.info@ices.dk; Website: http://www.ices.dk/symposia/tv_sym.htm)

1-4 April: The Oceanography Society's (TOS) Scientific Meeting: Ocean Interfaces, Seattle, Washington, USA. Contact: Judi Rhodes, The Oceanography Society, 4052 Timber Ridge Drive, Virginia Beach, Virginia, USA 23455 (Phone: 757-464-0131; FAX: 757-464-1759; Internet: jrhodes@ccpo.odu.edu; Website: http://www.tos.org/seattle_1997.html)

10-11 April: U.S. GLOBEC Scientific Steering Committee meeting, Boulder, CO, USA. Contact: H. Batchelder, Department of Integrative Biology, University of California, Berkeley, CA 94720-3140 (Phone: 510-642-7452; FAX 510-643-1142; Internet: halbatch@violet.berkeley.edu)

17-22 April: ICES/NASCO Symposium on Interaction of Salmon Culture and Wild Stocks of Atlantic Salmon: The Scientific and Management Issues, Bath, UK. Contact: L. P. Hansen, Norway (FAX: +47 73 91 54 33; Internet: lars.petter.hansen@nina.nina.no; Website: http://www.ices.dk/symposia/sa_sym.htm)

22-24 April: Fourth North Pacific Rim Fisheries Conference; Tokyo, Japan. Contact: Steve Cowper, US Co-Chair, North Pacific Rim Fisheries Conference, ACIB, UAA, 3211 Providence Drive, BEB 203, Anchorage, Alaska 99508, USA (Phone: 907-786-4300; FAX: 907-786-4319)

3-5 June: FMU Symposium: Fisheries Management under Uncertainty, Objectives and uncertainties in fisheries management with emphasis on three north Atlantic ecosystems., Bergen, Norway. Contact: FMU Symposium, Department of Fisheries and Marine Biology, Univ. of Bergen, Department of Fisheries and Marine Biology, Bergen Scientific Center, N-5020 Bergen, Norway (Phone: +47-55-584-456/or 400; FAX: +47-55-584-450; Internet: FMUsymp@ifm.uib.no; Website: http://www.ifm.uib.no/ANNET/FMU_SYMP/default.htm)

9-14 June: Symposium on Comparison of Enclosed and Semi-Enclosed Marine Systems: biological, physical and geochemical features and processes and responses to altered environmental conditions, Mariehamn, Aland, Finland. Contact: Ea Maria Blomqvist, BMB/ECSA -97, Huso Biological Station, Fin-22220, Emkarby, Aland, Finland (Phone: +358-(0)18-37221; FAX: +358-(0)18-37244; Internet: eric.bonsdorff@abo.fi or blomkvist@abo.fi)

31 August-19 September: The Summit of the Sea, St. John's, Newfoundland, Canada. Contact: Dave Finn, Summit of the Sea John Cabot 500th Anniversary Corporation, P.O. Box 1997, 1 Crosbie Place, St. John's, Newfoundland, Canada A1C 5R4 (Phone: 709-579-1997; FAX: 709-579-2067 Internet: david_finn@porthole.entnet.nf.ca; Website: <http://www.newcomm.net/cabot500/summit/>)

8-11 September: First International Symposium on Stock Enhancement and Sea Ranching, Bergen, Norway. Contact: PUSH, Bontelabo 2, N-5003 Bergen, Norway (FAX: +47-55-317395; Internet: borthen@telepost.no; Website: <http://www.imr.no/sear/hav97.html>)

16-19 September: 44th Annual Eastern Pacific Ocean Conference (EPOC), Stanford Sierra Camp, Fallen Leaf Lake, CA, USA. Contact: Jeff Paduan, Meeting Chairperson, Code OC/Pd, Naval Postgraduate School, Monterey, CA 93943 (Phone: 408-656-3350; FAX: 408-656-2712; Internet: paduan@nps.navy.mil) or Bill Peterson, EPOC Secretary, NMFS, Hatfield Marine Science Center, 2030 S. Marine Science Dr., Newport, OR (Phone: 541-867-0201; FAX: 541-867-0389; Internet: bpeterso@sable.hmsc.orst.edu)

22-24 September: ICES International Symposium: The Role of Physical and Biological Processes in the Dynamics of Marine Populations, Baltimore, MD, USA. Contact: ICES Secretariat, ICES, Palaegade 2-4, DK-1261, Copenhagen, Denmark (Phone: +45 33 15 42 25; FAX: +45 33 93 42 15; Internet: ices.info@ices.dk; Website: http://www.ices.dk/symposia/rp_symp.htm)

8-11 October: International Symposium on Fisheries Stock Assessment Models for the 21st Century: Combining Multiple Information Sources, 15th Lowell Wakefield Symposium, Anchorage, Alaska, USA. Contact: Brenda Baxter, Alaska Sea Grant College Program (Phone: 907-474-6701; FAX: 907-474-6285; Internet: fnbrb@aurora.alaska.edu)

9-10 October: U.S. GLOBEC Scientific Steering Committee meeting, Rutgers Univ., New Brunswick, NJ, USA. Contact: H. Batchelder, Department of Integrative Biology, University of California, Berkeley, CA 94720-3140 (Phone: 510-642-7452; FAX 510-643-1142; Internet: halbatch@violet.berkeley.edu)

17-26 October: PICES 6th Annual Meeting, Pusan, Korea. Contact: PICES Secretariat, c/o Inst. of Ocean Sciences, P.O. Box 6000, Sidney BC, Canada V8L 4B2 (Phone: 604-363-6366; FAX: 604-363-6827; Internet: pices@ios.bc.ca; Website: <http://pices.ios.bc.ca>)

27-31 October: NPAFC 5th Annual Meeting, Victoria BC, Canada. Contact: North Pacific Anadromous Fish Commission, 6640 Northwest Marine Drive, Vancouver BC, Canada V6T 1X2 (Phone: 604-228-1128; FAX: 604-228-1135)

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17-20 March: First Open Science Meeting of GLOBEC International, Paris, FR. Contact: Dr. Roger Harris, Plymouth Marine Laboratory, Prospect Place, Plymouth PL1 3DH, England (Phone: +44-1752-633 400, FAX: +44-1752-633 101, Internet: r.harris@pml.ac.uk)

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Workshop Report on Modeling the Southern Ocean Ecosystem

The following paragraphs represent the executive summary from a workshop report on discussions about Southern Ocean Ecosystem Modeling that occurred in January 1995. That meeting was collaboratively supported by the U.S. GLOBEC and U.S. JGOFS programs, in anticipation of upcoming field programs in the Southern Ocean by both programs. Mark Abbott (Oregon State University) chaired the workshop and compiled the report. The report of this workshop is being published jointly by the two programs. The report (No. 18 in the U.S. GLOBEC Report Series) is available in both html (on-line web viewing) and pdf (Adobe Acrobat) versions on the U.S. GLOBEC homepage at: <http://www.usglobec.berkeley.edu/usglobec/reports/reports.home.html>

Executive Summary

A workshop was convened 16-18 January 1995 to discuss modeling of the Southern Ocean ecosystem. Attendees included both modelers and sea-going oceanographers as well as representatives of both the Joint Global Ocean Flux Study (JGOFS) and Global Ocean Ecosystem Dynamics Experiment (GLOBEC). Both physical and biological oceanographers participated because of the strong links between physical forcing and biological processes in the Southern Ocean. Since this region is critical to global climate and biogeochemistry and because of the immense logistical difficulties in conducting field programs in the Southern Ocean, strong links must be developed and maintained between the modeling and observational communities.

Most numerical models of the upper ocean ecosystem are based on coupled partial differential equations with growth, loss, interaction, and diffusion terms. The basic model has been used in oceanography for many decades, although there have been many enhancements such as size classes, complex grazing and nutrient uptake terms, sophisticated mixed layer models, etc. As these models have grown in complexity, there are more adjustable parameters that must be estimated and more uncertainty about the exact forms of the parameterizations. Simple changes in parameters can have dramatic effects on model behavior. Several studies are investigating methods to reduce the number of parameters to those that capture most of the possible model behaviors.

As ocean models move towards a closer coupling with observations through data assimilation, it becomes essential that we know far more about the various parameters and functional forms than simply their mean and variance. Assimilation models require that we characterize the temporal and spatial variability of these parameters in order

to fill in the gaps in time and space. This is a daunting task. For example, we know decorrelation scales of phytoplankton biomass in only a few locations in the world ocean; little is known about the decorrelation scales of phytoplankton growth rates.

Numerical models, including data assimilation models, also require experimental design and sampling strategies directed towards the specific questions being addressed. Much of the field data that have been used to provide model parameters and functional forms was gathered to solve specific scientific questions and hypotheses that are not always related to the questions being addressed by the model. For example, models of the relationship between chlorophyll concentration and diffuse attenuation may be based on field measurements from tropical waters, and it is not appropriate to apply such functional forms in models of high latitude processes.

The Southern Ocean will be the site of major field campaigns for both JGOFS and GLOBEC. There is still great uncertainty about the regulation of primary productivity in the Southern Ocean; iron limitation, grazing, and light limitation have been invoked. Near the ice edge, processes are even more complicated. Existing coupled biological/physical models must contend with a wide range of processes, many of which (such as iron limitation) have not yet been incorporated into existing models.

Given the expanse of the Southern Ocean and its isolation, field programs are by necessity both limited and costly. The upcoming JGOFS and GLOBEC Southern Ocean projects represent a unique opportunity to collect data on Southern Ocean biogeochemistry and ecological processes. Campaigns by other countries, including the United Kingdom, Australia, France, Germany, Japan, and South Africa, will also provide important data sets along with long-term studies such as the Palmer Long Term Ecological Research (LTER) program. It is unlikely we will be able to assemble these resources again. Given the predicted sensitivity of the Southern Ocean to climate change (and the resulting feedbacks), we must improve our ability to make predictions about the functioning of the Southern Ocean with only limited data sets in the future.

Physical forcing is particularly intense in the Southern Ocean. Strong wind forcing, large seasonal (and interannual) variations in ice cover, and mesoscale eddies are some of the processes that play critical roles in Southern Ocean dynamics. Weak stratification (relative to waters at lower latitudes) gives rise to short dynamical scales. The internal radius of deformation decreases towards the south, ranging from 20 km to 8 km. Bottom topography has a much stronger effect on the flow than at mid-latitudes because weak stratification allows bottom disturbances to

(Cont. on page 14)

Develop. in GLOBEC—(Cont. from page 5) programme will involve a very large number of countries in studies in many different regions of the world ocean. Again, the GLOBEC SSC and its SPACC working group are directly responsible for the planning and implementation of SPACC.

Finally, there are two large-scale studies, each of which is confined to a single ocean basin, which are being planned by regional oceanographic organisations in very close co-operation with GLOBEC. While individuals involved in each of these studies provide scientific input to the international GLOBEC SSC, the lead responsibility for these programmes is taken by the regional organisation as its contribution to the GLOBEC programme. These programmes are the Cod and Climate programme in the North Atlantic Ocean which is cosponsored by GLOBEC and the International Council for the Exploration of the Sea (ICES), and the North Pacific programme on Climate Change and Carrying Capacity of the North Pacific Marine Science Organisation (PICES) and GLOBEC.

GLOBEC Southern Ocean Program

(SO-GLOBEC) The SO-GLOBEC program is focused on understanding how physical forces influence population dynamics and predator-prey interactions between key species. Special efforts will be made to study the little-known overwintering strategies of zooplankton and top predators. The knowledge gained will significantly advance understanding of Southern Ocean marine ecosystems and will enable us to adequately monitor and predict the impact of climate change.

Planning for a Southern Ocean GLOBEC program has been developed at a number of meetings and working groups (GLOBEC Reports Nos, 5 & 7), and issues of implementation are now being considered as a matter of urgency by the new SSC. A new Southern Ocean Working Group has been established under the Chairmanship of Eileen Hofmann.

Small Pelagic Fishes and Climate Change (SPACC) SPACC aims to identify linkages between the physical forces that control growth of small pelagic fish populations (sardines, anchovies, scads, herrings, mackerels,

sprat, menhadens and others). The long-range goal is to forecast how changes in the patterns and intensity of these forces, caused by elevated greenhouse gases and global warming, will alter the productivity of small pelagic fish populations.

SPACC planning has already involved major workshops in Mexico (GLOBEC Report No, 8) and Namibia, and further consideration of implementation was made at a meeting in Mexico City in August 1996.

ICES - GLOBEC Cod and Climate Change Program (CCC or "3Cs")

The International Council for the Exploration of the Sea (ICES) and GLOBEC have joined together to develop an innovative program to advance the understanding and prediction of variability in fish stock recruitment, both in the short term (annual forecasts) and in the long term ("climate effects"). Cod was chosen for this exercise because its biology is well-known and supported by ample data bases. It has a pan-Atlantic distribution, and its abundance and distribution have been shown to be sensitive to specific past examples of climate variability.

(Cont. on page 11)

The GLOBEC Report Series is published by the GLOBEC INTERNATIONAL Secretariat's office and includes the following:

1. **Towards the Development of the GLOBEC Core Program: A report of the First International GLOBEC Planning Meeting. GLOBEC Report No. 1. SCOR.**
2. **Population Dynamics and Physical Variability: Report of the First meeting of an International GLOBEC Working Group. GLOBEC Report No. 2. SCOR.**
3. **Sampling and Observational Systems: Report of the First Meeting of an International GLOBEC Working Group. GLOBEC Report No. 3. SCOR.**
4. **Cod and Climate Change: Report of the First Meeting of an ICES/International GLOBEC Working Group. GLOBEC Report No. 4. SCOR.**
5. **Development of an International GLOBEC Southern Ocean Program. Report of the first meeting of the International GLOBEC working group. GLOBEC Report No.5. SCOR.**
6. **Numerical Modelling. Report of the first meeting of the International GLOBEC working group. GLOBEC Report No.6. SCOR.**
7. **Southern Ocean Implementation Plan. GLOBEC Report No.7. SCOR.**
8. **Small Pelagic Fishes and Climate Change Program. Report of the first planning meeting. GLOBEC Report No.8. SCOR.**

Develop. in GLOBEC—(Cont. from p.10)

These considerations provide the possibility of developing new capabilities in predicting fish recruitment from a better understanding of the interaction of physical processes and population dynamics. Planning for CCC is described in GLOBEC Report No, 4.

PICES-GLOBEC Climate Change and Carrying Capacity (CCCC or "4Cs") The North Pacific Marine Sciences Organization (PICES) and GLOBEC are jointly organizing a program on Climate Change and Carrying Capacity (CCCC) in the temperate and subarctic regions of the North Pacific Ocean. The general scope of the CCCC Program has a strong emphasis on coupling between atmo-

spheric and oceanographic processes, their impact on the production of major marine living resources and how they respond to climate change on time scales of decades to centuries. Particular emphasis is being placed on regime shifts, and on the biology of salmonid stocks.

Developing National and Regional Programs

A major future priority of the GLOBEC SSC is to work closely with National GLOBEC committees and emerging regional programs to ensure effective co-ordination and integration, and to realize the full research potential of these regional initiatives. Many such GLOBEC activities are well estab-

lished, productive, and ongoing, for example the US George's Bank Program. It is a strength of the international program that there is already so much GLOBEC research momentum.

A further good example of such a regional development is the establishment of the TASC (TransAtlantic Study of *Calanus finmarchicus*) project, which is described in the article by Charlie Miller in this issue (page 6).

Dr. Roger Harris is a zooplankton ecologist at the Plymouth Marine Laboratory and the chairman of International GLOBEC. For further information about International GLOBEC, contact Roger at Plymouth Marine Laboratory, Prospect Place, Plymouth PL1 3DH, United Kingdom (Tel: +44-1752-633400; FAX: +44-1752-633101; email:r.harris@pml.ac.uk) △△△

Changes in U.S. GLOBEC Scientific Steering Committee

The terms of Allan Robinson (Harvard University), Paul Bentzen (University of Washington), and Ted Strub (Oregon State University) on the U.S. GLOBEC SSC expired at the end of 1996. Allan was a long-time member of the SSC (having served two terms of 3 years each), served as the chair of the Long-Range Planning Committee and was principal author of the U.S. GLOBEC Long-Range Science Plan (U.S. GLOBEC Report No. 12), and was especially active in GLOBEC International activities. Paul, leaving the committee after serving one term, was actively involved in the preparation of the Northeast Pacific Implementation Plan, and often reminded the committee of the value of genetic and molecular approaches for studying population dynamics and structure in the marine environment. Ted's contribution to the U.S. GLOBEC program has been immense. He chaired, or co-chaired three workshops and was the principal author for two reports (U.S. GLOBEC Reports No. 7 and No. 11) on the

California Current System and was an active participant in numerous other workshops and reports. Recognizing his past contributions to the program, and perhaps hoping to get more in the future, the SSC renominated Ted to serve another three year term. Ted agreed to stand for reelection and was unanimously re-elected.

Also at the end of 1996, the terms of two ex-officio members of the SSC, Brian Rothschild and Bill Peterson, expired. Brian has served on the SSC, either as a regular or ex-officio member, since the SSC was formed. Partway through this period, Brian became the Chair of GLOBEC International (at which time he became ex-officio on the U.S. SSC) and led that fledgling program through its initial startup phase to eventual acceptance as a core project of the IGBP. Bill served as ex-officio on the SSC for one year following three years as the U.S. GLOBEC program manager in NOAA headquarters in Silver Spring, Maryland. It is largely through the efforts of Bill as program manager that the

program stands in as good as stead as it does, and we thank him for his service to the program, both as program manager and later on the SSC.

U.S. GLOBEC accepted nominations for new SSC members until late-December 1996. We especially encouraged nominees with backgrounds in salmon/fisheries oceanography, genetics, and zooplankton ecology. We were pleased to receive numerous well-qualified nominations. Following established procedures, the U.S. GLOBEC SSC welcomes four new members: Bill Pearcy (Oregon State University), Bob Francis (University of Washington), Stewart Grant (NOAA), and Mike Dagg (LUMCON). They and Ted Strub have terms that expire in December 1999.

Other members on the SSC are Bob Beardsley, Loo Botsford, Mike Fogarty, Dale Haidvogel, Eileen Hofmann, Anne Hollowed, Mark Huntley, Val Loeb, Dave Mountain, Peter Ortner, Tom Powell (chair), Steve Reilly, Jim Schumacher, and Jose Torres. △△△

ICES International Symposium on Recruitment Dynamics of Exploited Marine Populations: Physical-Biological Interactions

Baltimore, Maryland USA
22-24 September, 1997

Objectives and Scope

The interplay between environmental variation and population regulation controls the dynamics of marine populations. The principal objective of this Symposium is to explore the biotic and abiotic determinants of recruitment variability. Our focus is on higher trophic levels encompassing fish, macroinvertebrate, and marine mammal populations. We encourage interdisciplinary contributions on the role of physical and trophic processes in recruitment dynamics. We welcome descriptions of new technological advances, methodologies, and analytical approaches and solicit contributions examining the problem of recruitment processes along a continuum of spatial and temporal scales.

Over a quarter of a century has now passed since ICES sponsored the highly influential symposium, Fish Stocks and Recruitment, in Aarhus Denmark in 1970. We seek to provide an overview of progress in understanding recruitment processes since this landmark meeting. The Symposium is dedicated to the memory of Professor R. J. H. Beverton, colleague, mentor, and friend to the ICES community.

Topics

Contributions are encouraged in, but not limited to, the following research areas:

Trophodynamics and Recruitment Success. We solicit contributions on the role of physical processes and hydrographic structures (e.g. turbu-

lence, fronts, stratification) in relation to demographic rates and processes. Contributions which examine the importance of physical features relative to tradeoffs between growth and risk of predation are welcomed. We encourage contributions on the role of predation mortality in controlling year class success, field and laboratory studies of predation processes in marine systems, and the development of recruitment models incorporating predation effects.

The Symposium is dedicated to the memory of Professor R. J. H. Beverton, colleague, mentor, and friend to the ICES community.

Physical Transport, Retention, and Loss. Transport and dispersal mechanisms are hypothesized to have a profound influence on survival rates and population structure in the sea. We seek studies of the importance of retention and loss on early life stage dynamics. We encourage contributions on the role of mesoscale hydrographic features in recruitment processes including the specificity of spawning times and locations and transport to suitable nursery locations from spawning sites.

Climate Variability and Recruitment Processes. Documentation of causal factors underlying regime shifts in the marine environment is essential. Studies of synchrony in recruitment among different taxa or populations

within species on large spatial scales have provided important insights into recruitment processes. We seek contributions which provide a broad-scale context for understanding recruitment variability and the implications of longer-term shifts in environmental conditions as a guide to possible effects of climate change on marine populations.

Population Regulation and Environmental Variability. The resilience of populations to exploitation is critically dependent on compensatory processes. Compensation can dampen the effects of environmentally-induced variability in recruitment. We seek contributions examining compensatory mechanisms at one or more life history stages, stock-recruitment models with environmental inputs, and analyses of interactions between environmental variability and internal regulatory mechanisms.

Life History Strategies in Variable Environments. Marine populations exhibit a diverse array of life history strategies in response to environmental variability. We encourage contributions examining fundamental life history characteristics in relation to recruitment processes. Examples of life history characteristics in relation to variable marine environments, comparative studies of life history traits across taxa, and the implications of different life history strategies in relation to anthropogenic perturbations.

(Cont. on page 13)

Symposium Structure

The Symposium will feature invited presentations providing overviews of key issues in understanding the linkages between environmental variability and population dynamics. Contributed papers will be presented in sessions addressing principal topics; posters will be displayed throughout the Symposium. A session devoted to synthesis and discussion of the principal themes of the Symposium will conclude the meeting. Our objective throughout is to encourage an interdisciplinary approach to understanding recruitment processes. The official language of the symposium will be English.

Publication

The Symposium proceedings will be published as a special issue of the ICES Journal of Marine Science. Invited and contributed papers, including poster presentations, will be considered for publication following peer review. Copies of the proceedings volume will be sent to Symposium participants.

Date and Venue

The Symposium will be held September 22-24, 1997, on the campus of the Johns Hopkins University, Baltimore, Maryland, USA

Participation

The Symposium is open to all scientists and students with interest in the interaction between marine environmental processes and recruitment dynamics. Requests for information should be directed to Dr. Fogarty. Contributors to the Symposium are requested to submit titles of their presentations with abstracts of 250 words or less to Dr. Fogarty by 1 March 1997. Due to time constraints, the number of papers that can be

accepted for oral presentation will be limited. Authors of the contributions accepted by the Scientific Steering Committee for presentation will be notified by 1 May, 1997 and will receive instructions concerning the coding, format, and mailing of the work to be submitted. The registration form should be returned by 1 July, 1997 with the registration fee (see below). Final abstracts of 250 words or less will be due by 1 August 1997 for inclusion in a volume of collected abstracts to be distributed before the symposium. Written papers will be due by 1 September 1997. (Posters should be brought to the Symposium, ready for display on the opening day). The registration fee is US \$75.00 (US \$25.00 for students); it will include the cost of the Symposium proceedings, lunches, and other incidentals but not accommodation.

Important Dates

1 March 1997	Abstracts of all contributions
1 May 1997	Notification of acceptance
1 August 1997	Final Abstract for Distribution
1 September 1997	Written Paper

Symposium Co-sponsors

Co-sponsors of this symposium are: Scientific Committee on Oceanic Research, North Pacific Marine Science Organization, Intergovernmental Oceanographic Commission, GLOBEC International, US National Science Foundation, US Office of Naval Research, US National Marine Fisheries Service, US GLOBEC, GLOBEC Canada, The Johns Hopkins University, and the University of Maryland System Center for Environmental and Estuarine Studies.

Scientific Steering Committee

Co-Conveners for the meeting are:

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Mr. H. Loeng, Institute of Marine Research, P.O. Box 1870 Nordnes, 5024 Bergen, Norway (harald.loeng@imr.no)

Prof. T. R. Osborn, Department of Earth and Planetary Sciences, The Johns Hopkins University, Baltimore, MD 21218 USA (osborn@jhu.edu)

Prof. J. G. Shepherd, Southampton Oceanography Centre, Southampton University, Highfield, Southampton SO9 5NH U.K. (j.g.shepherd@soc.soton.ac.uk)

The Scientific Advisory Committee for the symposium consists of:

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Prof. T. M. Powell, Department of Integrative Biology, University of California, Berkeley, CA 94720 USA (zackp@violet.berkeley.edu)

Prof. B. J. Rothschild, University of Massachusetts at Dartmouth, 285 Old Westport Road, Dartmouth, MA 02747 USA (brothschild@umassd.edu)

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penetrate to the surface. Coupled with the smaller dynamical scale, this means that small topographic features can have large-scale dynamical effects. This physical environment has strong links with biological processes that must be accounted for in both our field and modeling programs.

The focus of the workshop was an assessment of our present state of knowledge from both observations and models. We assessed where our greatest uncertainties lie and where small improvements in observation strategies and models would result in large increases in understanding. We estimated the time and space scales over which we can make useful predictions about the Southern Ocean. As part of this assessment, we explored the needs of the observational community in terms of models. We also sought to outline the type of measurement program that would lead to significantly improved models.

Workshop Recommendations

Increase accessibility to numerical models by observationalists. As observations become more sophisticated in terms of both the processes that can be measured and the scales that can be resolved (both microscales and global scales), models have assumed new importance as a framework within which data may be interpreted. Moreover, the increasing focus on studies of coupled biological/physical processes and the need for scientific research to focus on the prediction of ecosystem response to climate change has also elevated the role of numerical modeling. Thus the complexity of both models and observations require a much closer interaction between those who build and operate models and those who collect and analyze data.

1. Encourage Southern Ocean JGOFS and GLOBEC activities that have both a modeling and a field component

2. Develop a variety of models focusing on specific processes or hypotheses but with clearly defined interfaces and documented assumptions so that other researchers can understand and evaluate the models
3. Archive output of numerical models much as field and satellite observations are archived and distributed
4. Encourage the development of models that are structured as a set of testable hypotheses that can be addressed by appropriately designed sampling strategies

Improve modeling capabilities in advance of Southern Ocean field studies for use in designing sampling programs and analyzing data.

Emerging research areas, such as data assimilation and nested models, would benefit by expanded research in advance of the JGOFS and GLOBEC field programs. Various diagnostic techniques, such as estimating advective fluxes, could be used to design specific sampling strategies at the Southern Ocean station sites.

1. Encourage modelers to work with researchers participating in the Southern Ocean JGOFS and GLOBEC field studies
2. Encourage development of data assimilation techniques for biogeochemical modeling
3. Continue development of embedded or nested models which incorporate high resolution models within lower resolution models
4. Use models to simulate advective fluxes around planned Southern Ocean stations and compare with observations as part of model diagnostics.

Improve observing capabilities to take advantage of and test numerical models. Present models point towards the need for better estimates of rate parameters as well as more detailed information on size and functional classes in the plankton community.

Improvements in data assimilation techniques will require better estimates of the error fields associated with the assimilated data sets. Efforts should be placed towards the development of low-cost sensors to extend the scales that can be observed.

1. Evaluate present JGOFS core observations in context of the needs of existing numerical models
2. Develop models that resolve critical time and space scales as identified in field measurements
3. Collect information on size and functional groups
4. Quantify error covariances for data fields that are assimilated into models
5. Continue to encourage the development of new automated and low-cost sensors to extend sampling coverage of the Southern Ocean

Establish a regular program to further the development of coupled physical/biogeochemical models.

Models of the Southern Ocean ecosystem must resolve complex physical dynamics as well as complicated chemical and biological interactions. Because of the nature of the circulation in this vast region of the ocean, these models must have high spatial resolution as well. Our overall goal should be the development of a closer alliance between models (which will always be gross simplifications of reality) and observations (which will always provide a biased and undersampled view of reality). We should continue activities that strengthen the links between these two complementary ways of looking at a complex system.

1. Regularly assess the state of our knowledge and modeling capabilities
2. Support annual workshops where models can be run and evaluated by both modelers and observationalists.

(Mark Abbott is a Professor of Biological Oceanography at Oregon State University.)

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SPACC Working Groups Established

At the second Implementation Plan Meeting of SPACC (Small Pelagic Fish and Climate Change), held 19-23 August 1996 in Mexico City, 10 new Working Groups were established to continue SPACC work. Terms of Reference (TOR), names and e-mail addresses of WG Chairmen are given below. All Working Groups are open for anybody wishing to participate.

WG on Modeling. TOR: Develop a modeling implementation plan to integrate the products generated by the working groups to predict the effects of climate change on populations of small pelagic fishes (Jarre-Teichmann, ajt@dfu.min.dk; Moisan, moisan@drifter.ucsd.edu; Moloney, cmoloney@sfri.sfri.ac.za)

WG on Decadal Changes of Ecosystems. TOR: Develop an implementation plan on how to use existing time series of data and modeling to investigate how large scale variability of the coupled ocean-atmosphere system affects ecosystems in which small pelagic fishes are important (Alheit, juergen.alheit@io-warnemuende.de; Crawford, crawford@sfri.sfri.ac.za)

WG on Comparative Population Dynamics. TOR: Calculate and compare the total production per unit biomass and per unit spawning habitat for all species of small pelagic fishes considered by SPACC and for which sufficient data exist (Jacobson, larryj@ucsd.edu; Serra, rserra@ifop.cl)

WG on Paleoecology. TOR: Reconstruct and compare between Pacific and Atlantic fish population histories and associated ecosystem changes inferred from sediment samples. Reconstruction will concentrate on decadal through centennial temporal increments over the past 2000 years (Baumgartner, trbaumgartner@ucsd.edu)

WG on Genetics. TOR: Develop an implementation plan for a SPACC

genetics programme which identifies population units, validates current species designations, estimates rates exchange among metapopulations and models effects of climate change and population collapse on genetic variability (Grant, stew.grant@noaa.gov)

WG on Daily Growth and Zooplankton. TOR: Develop a SPACC implementation plan to determine how climate variability affects productivity of small pelagic fish populations by comparing daily somatic growth of young fishes, plankton production and physical forcing among ecosystems (Butler, jbutler@its.ucsd.edu; Sanchez, rsanchez@inided.edu.ar)

WG on Spawning and Nursery Habitat Quality and Dynamics. TOR: Develop a comparative SPACC research implementation plan to assess the effects on fish population growth on changes in the quality and dynamics of spawning and nursery habitat (Roy, croy@orstom.fr; Castro, lecastro@halcon.dpi.udec.cl)

WG on Spawning Habitat Dimensions. TOR: Design a comparative SPACC research implementation plan to assess the effects on population growth of changes in the spatial and temporal dimensions and location of the spawning habitat of small pelagic fishes (Hunter, john.hunter@noaa.gov; van der Lingen, vdlingen@sp.sfri.ac.za)

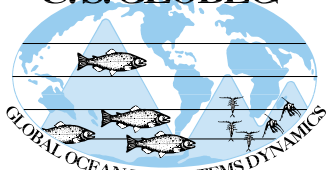
WG on Resource Availability. TOR: Develop an implementation plan to determine how spatial distributions of small pelagic fishes are affected by major shifts in ocean climate (Freon, freon@orstom.rio.net; Botsford, lwbotsford@ucdavis.edu)

WG on Economic Consequences. TOR: Develop a plan and determine the economic effects of climate induced changes in small pelagic fishes considering both the short-term effects such as El Nino as well as long-term decadal changes in ocean climate (No

Chair yet)

The SPACC Implementation Plan is under preparation. For further information contact John Hunter, USA, Fax: +1-619-546 5656; e-mail: john.hunter@noaa.gov or Juergen Alheit, Germany, Fax: +49-381-5197 440; e-mail: juergen.alheit@io-warnemuende.de. △△△

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U.S. GLOBEC NEWS

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Hal Batchelder
Tom Powell
Kay Goldberg

ing mortality rates. In all systems where we are studying *C. finmarchicus*, the variations in TASC field abundance estimates are (or are certain to be) far too large to allow application of mortality estimators based on stage-to-stage abundance changes like those of Woods. Perhaps there are things we cannot simply choose to know by working hard enough. It was evident at the meeting that a large part of the ecology of *C. finmarchicus* is determined by interaction with predators. Some of this is fixed at the evolutionary time scale; some is variable behavior on time scales of days or less. An open task for TASC is to include in models this dependence of behavior variations on predators. Some of Oyvind Fiksen's work using optimality criteria and dynamic programming is a

good start. More of Stein Kaartvedt and Dag Aksnes's extraordinary qualitative insights should help, too.

TASC-II included several sessions on Trans-Atlantic integration. Peter Wiebe and Kurt Tande (western and eastern head honchos) will cover those deliberations in a forthcoming article in the TASC newsletter.

Roger Harris, Kurt Tande and I were convenors for this meeting. We wish to thank all the participants for coming far, for preparing well and for sharing in the good times at Gileje. Thanks to everyone involved in TASC who made our sharing of good new results and plans possible; the meeting showed what a fine adventure TASC has become. We're sorry that we could

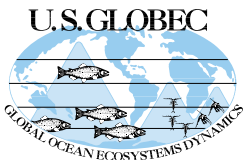
not get absolutely everybody to the meeting, but somebody had to be out on the boats. If somebody at the meeting was not included in this report; please write an essay for the TASC newsletter retelling your story.

Finally, at an evening business meeting, Katherine Richardson and Mike Heath volunteered to take over the newsletter for at least as long as I am in France. It has been a pleasure to produce the first issues, and I plan to contribute to more. I cannot easily do it from here, so many thanks to Mike and Katherine for taking over.

(Charlie Miller, Professor of Oceanography at Oregon State University, is currently on sabbatical at the Station Zoologique, Villefranche-sur-Mer, France.)

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