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NEWSLETTER

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GLOBEC Editorial

Manuel Barange, GLOBEC IPO, Plymouth, UK (m.barange@pml.ac.uk)

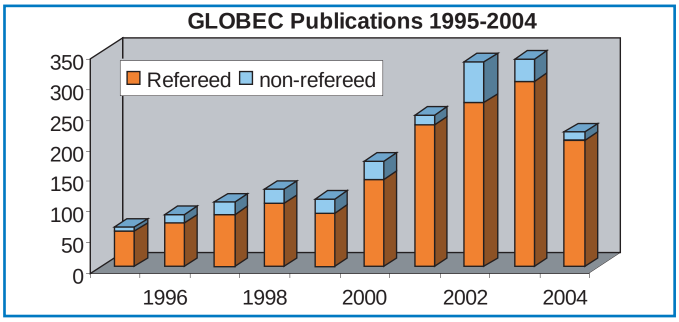

Figure 1. Number of GLOBEC publications 1994 to 2004.

Scientific programmes go through a number of stages. The beginnings are always difficult; money is tight and networking seems a bit of a hit and miss affair. A frantic implementation period follows, characterized by intensive field work and the development of teams and contacts. During this period programmes develop their identity and image, which is an essential process before glue funding starts to trickle in. The next step involves the steady production of research outputs, scientific publications and symposia. Through this stage there is a period of maturation, perhaps involving revising original objectives and goals, discovering new research paths not envisaged beforehand, and on the whole preparing the stepping stones that would ensure a successful scientific legacy. GLOBEC is firmly in this period, when the efforts of past years are starting to bear fruit.

Over the last 3-4 years GLOBEC has produced between 200-400 research publications per year (Fig. 1), the large majority of them peer-reviewed. These records come from GLOBEC-logged databases, which are likely to underestimate production (if you do not tell us we are less likely to know about your GLOBEC publications). To be accepted as a GLOBEC product a publication must mention the term GLOBEC or the name of a GLOBEC-affiliated programme (e.g. SPACC) in the text, so many papers produced under the GLOBEC umbrella never get logged. Nevertheless, this publication rate demonstrates the maturity of the programme. Special journal issues collating work along regional lines, arguably GLOBEC's most successful scale of implementation, appear in journals with increased regularity. For example, I would like to note the recent DSR II volumes on Southern Ocean GLOBEC and NEP US GLOBEC (Fig. 2). Recent and forthcoming regional symposia, such as the May 2005 GLOBEC Symposium on "Climate variability and sub-arctic marine ecosystems" in Victoria, Canada, or the April 2006 PICES/GLOBEC symposium on "Climate variability and ecosystem impacts on the North Pacific: a basin-scale synthesis" in Honolulu, USA, will no doubt boost GLOBEC's publication record.

This maturity stage is also conducive to the development of new ideas and re-focusing past efforts. With the last GLOBEC Newsletter you all received science plans for two new GLOBEC regional programmes (ESSAS and CLIOTOP). These new programmes are essentially integrative and synthetic, building on past GLOBEC research and re-focusing the science as a result. GLOBEC is also starting a new activity on "End to End Food Webs" in collaboration with the recently-

Figure 2. Recent GLOBEC special issues of Deep-Sea Research II: SO GLOBEC and North-East Pacific GLOBEC.

A CORE PROJECT OF THE GLOBAL IGBP CHANGE INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME
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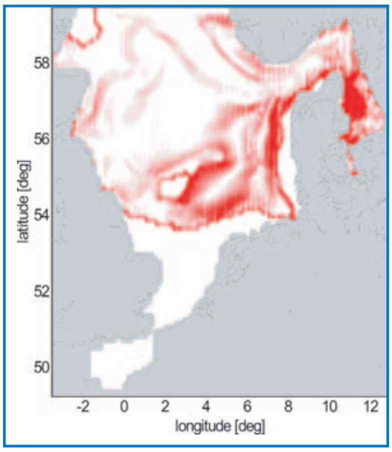
Scientific Committee on Oceanic Research

approved SCOR/IGBP programme IMBER. A writing team chaired by Dr Colleen Moloney (South Africa) and Prof Mike StJohn (Germany) has been appointed to develop the scientific vision. We hope to inform on their work in future newsletters.

The final stage of a programme involves the definition of its scientific legacy, a stage that requires clear vision and a steady hand. GLOBEC will have to face this challenge in a reasonably near future. This Newsletter should remain a key mechanism to check the pulse of GLOBEC during that crucial stage.

Workshop on Indices of Meso-scale Structures 22-24 February 2006, Nantes, France

Benjamin Planque, IFREMER, Nantes, France (bplanque@ifremer.fr)



Example of automatic frontal detection from models results, in the North Sea.

Long-term indices of ocean climate are generally based on large scale atmospheric or oceanic features such as NAO or basin inflow/outflow. Such indices only have a limited potential for indicating the climatic induced changes in fish distribution, biomass or recruitment processes since the scale of the physical processes described is much larger than the scale at which fish behaviour is understood. Process understanding of fish response to the environment is generally more obvious at the meso-scale (10-100km, days-weeks) where oceanographic features such as fronts, plumes, upwelling or eddies occur. Hence, understanding of fish response to climate compatible with process understanding requires that meso-scale oceanic features be detected and tracked over long period of times.

The aim of the workshop is to apply automatic detection of meso-scale hydrological structures in a number of systems in order to provide long-term time series of these indices. These new time-series would complement those of existing indices (e.g. regional SST, NAO, Baltic inflow, etc.). The ultimate goal will be to relate time-series meso-scale indices to times series of fish populations on the basis of process understanding gained at the meso-scale by field and process studies.

Activities include:

review numerical methodologies for the construction of indices of meso-scale structures such as fronts, eddies, transport, upwelling, and vertical hydrographic changes, disseminate available tools and software for the automatic detection of meso-scale structures, construct long-term (>10 years) time series of indices of meso-scale structures for a number of systems.

Participants are invited to contribute to the workshop by providing presentations on meso-scale analysis techniques, data analysis tools and/or hydrodynamic simulation outputs. Deadline for submission is 31December 2005. For information/submission, please contact the co-chairs: Benjamin Planque (bplanque@ifremer.fr) and Corinna Schrum (schrum@dkrz.de), additional information will be posted at www.ifremer.fr/wkims

The workshop is supported by the ICES Working group on Modelling Physical Biological Interactions and the ICES Study Group on Regional Scale Ecology of Small Pelagics, and endorsed by EUR-OCEANS and GLOBEC International. Additional support is provided by the Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER).

CONTENTS

Workshop on advancements in modeling physical-biological interactions in fish early-life history: recommended practices and future directions 3-5 April, 2006, Nantes, France

Co-chairs: Alejandro Gallego[1], Elizabeth North[2] and Pierre Petitgas[3]
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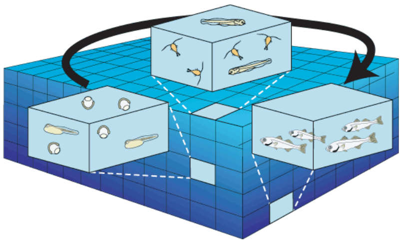
Advancements in modeling physical-biological interactions in fish early-life history:



Recommended practices and future directions

An international workshop will be held on 3-5 April 2006 to evaluate the present state and next steps in the developing field of modelling physical-biological interactions in lake, estuarine, shelf, and oceanic ecosystems. The ***W**or**K**shop on **A**dvancements in **M**odeling physical-biological interactions in the early-life history of **F**ish: best practices and future directions* (WKAMF) will be held under the auspices of the International Council for the Exploration of the Sea (ICES) Working Group on Physical-Biological Interactions and the ICES Working Group on Recruitment Processes. It will be hosted by the French Research Institute for Exploitation of the Sea (IFREMER) Center in Nantes, France with support from IFREMER, the US National Science Foundation, the UK Fisheries Research Services, the University of Maryland Center for Environmental Science, and is endorsed by GLOBEC and EUR-OCEANS. The workshop will focus on recent advances in coupled biological-physical models that incorporate predictions from three-dimensional circulation models to determine the transit of fish eggs and larvae from spawning to nursery areas. These coupled bio-physical models have been applied to gain new insight on how planktonic dispersal, growth and survival are mediated by physical and biological conditions and have contributed to enhanced understanding of fish population variability and stock structure.

The workshop is designed to survey major components of bio-physical models of fish early life, address numerical techniques and validation issues in each of these components, and will aim to define recommended modeling practices as well as identifying future research needs. The workshop will focus on aspects of modeling fish early-life history including: initial conditions (egg production, spawning location/time), small-scale processes (turbulence, feeding success), mesoscale transport processes (physics and larval behaviour), and biological processes (development, growth, mortality, juvenile recruitment, metamorphosis, settlement). Workshop results will provide guidance and direction for integration of coupled bio-physical models with observing systems, operational models, monitoring programs, and ultimately to improve fisheries management recommendations. In addition to enhancing the field of physical-biological interactions, this workshop will foster information exchange and support collaborations between international workshop participants.

The workshop will include presentations, posters, general discussions, and writing sessions. Invited and contributed presentations, a poster session, and structured discussions will take place on 3 and 4 April to survey recent advances in the field, develop a list of recommended practices, and identify research needs. The final day of the workshop will include focused writing sessions devoted to identifying funding sources and developing teams for international collaborative proposals. Space and funding requirements limit participation to 50 people on 3-4 April with smaller focused writing groups on 5 April. The abstract deadline for contributed talks and posters is 1 December 2005. More information about the workshop can be found at the WKAMF web site http://northweb.hpl.umces.edu/wkamf/home.htm.

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GLOBEC SCIENCE

A column for scientific notes of relevance to the GLOBEC community

GLOBEC Norway

Zooplankton-fish interactions and the fat conveyor-belt in the Norwegian Sea

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The direct linkages between zooplankton and fish are not always easily detected, but in the Norwegian Sea we found a strong linkage between the development of fat reserves in Calanus finmarchicus and the rapid fattening of Norwegian spring-spawning (NSS) herring. This fat is transported by the herring – perhaps the largest biogenic transport of energy in the oceans - to the coastal food web with positive effects on species such as lobsters and puffins. This suggests that fat produced mainly by diatoms across the Norwegian Sea enters a major fat conveyor-belt (Fig. 1a): first collected by C. finmarchicus, then consumed by herring – which transport it to the coast, store it over winter and spread it with their eggs along the Norwegian coast. Herring eggs are then eaten by benthic organisms such as lobster and haddock, whereas the developing pelagic larvae are important for other species, for instance the Atlantic puffin. The migration by the large herring stock is the key to these subsidies of the coastal ecosystem.

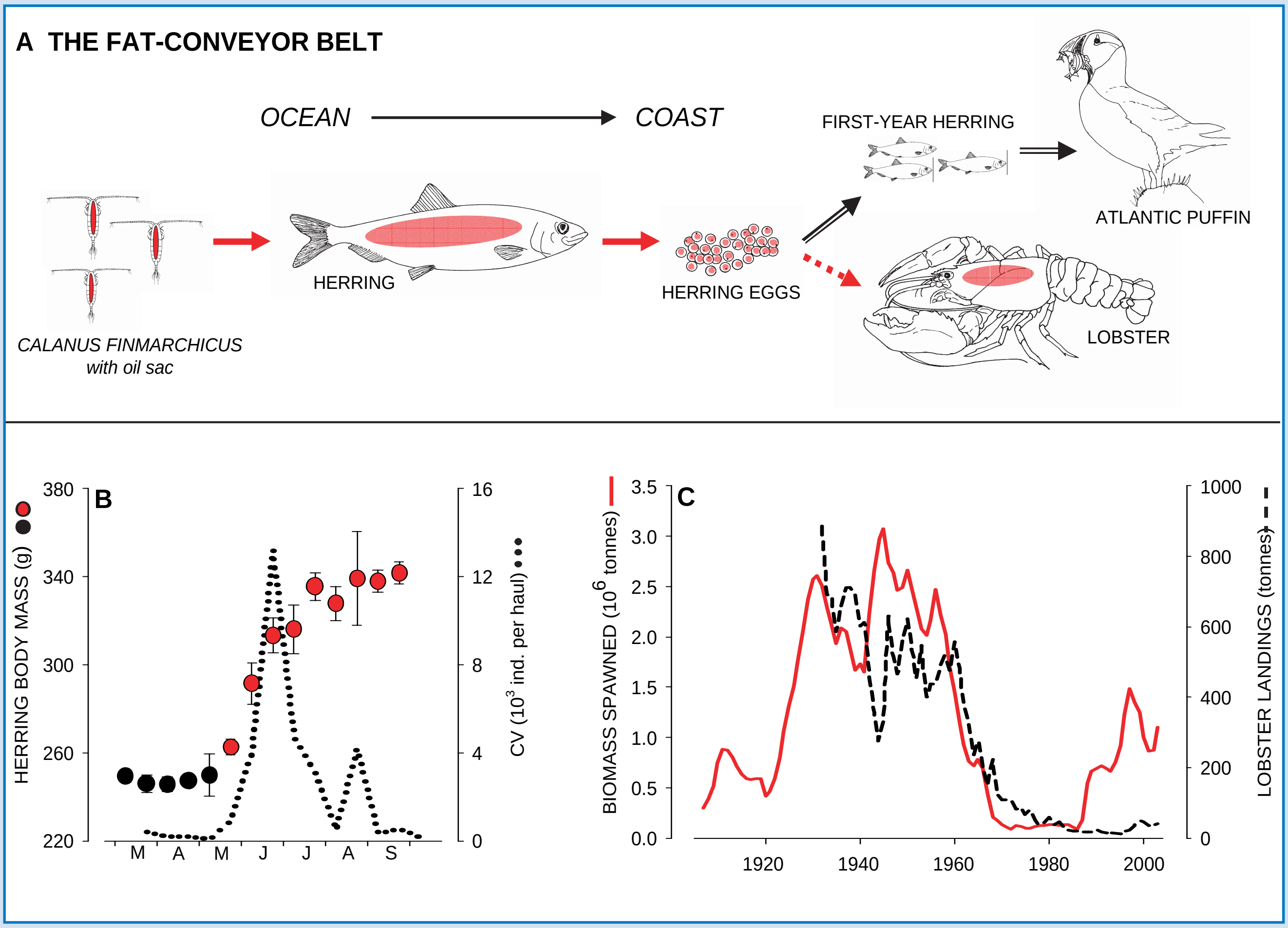
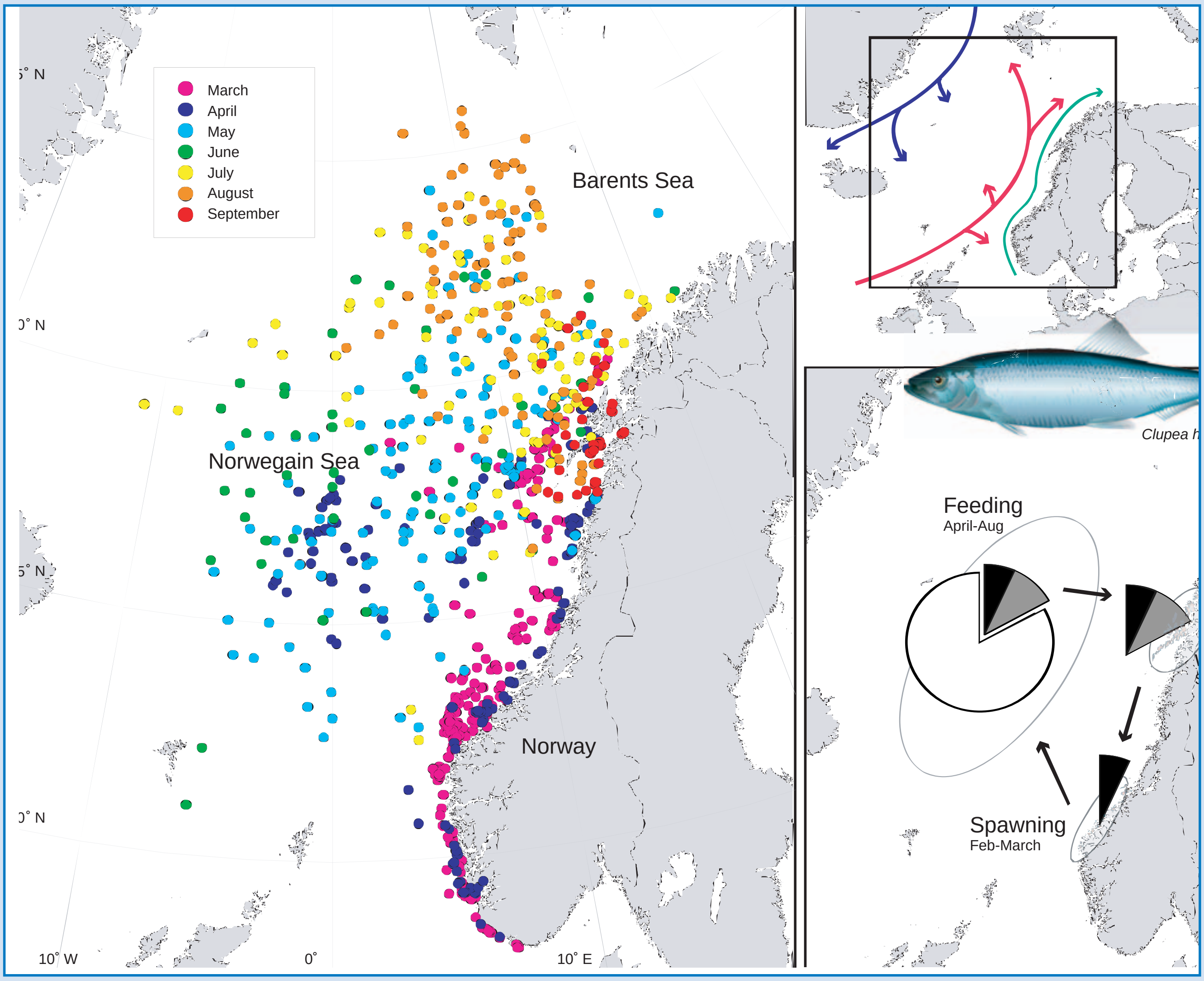


Figure 1. Biomass transport from ocean to coast. (A) The fat conveyor-belt. C. finmarchicus build lipid stores, herring prey on C. finmarchicus, and herring migrate to the coast with large lipid stores after the feeding season. The lipids are used for egg production at the coast next spring and are important food for coastal species, possibly also lobster, whereas Atlantic puffins rely on first-year herring as food for their chick. The fat flow is indicated in red. (B) Changes in body mass of herring (body length of 30 cm), and seasonal abundance of C. finmarchicus (CV, 0-100m) at Station M in the Norwegian Sea (extracted from Østvedt 1955). (C) The biomass of reproductive output (eggs and milt) left at the coast during the last century and the landings of lobster in Western Norway. Figures B and C are adapted from Varpe et al. (in press)

Figure 2. The distribution, migration, and energy transport by Norwegian spring-spawning herring. Left: catches from the Norwegian Sea and the Norwegian Coast (1990–2003) included in the study. Catches are presented for the feeding period (March–September). Lower right: main feeding, overwintering and spawning area and the energy transport caused by NSS herring; 17% (grey and black) is transported to the coast and 7% (black) is left as reproductive output. Black arrows indicate migration direction. Upper right: Norwegian Atlantic Current (red), Norwegian Coastal Current (green) and East Greenland Current (blue). Gulf of Maine Research Institute made the herring drawing. The figure was published in Varpe et al. (in press).



Fisheries and behavioural changes in migration can therefore affect this meta-ecosystem coupling.

Here we summarize results from a recent study on the interactions between *C. finmarchicus* and NSS herring (*Clupea harengus*) in the Norwegian Sea (Varpe *et al.*, in press). Seasonal migrations are important parts of the annual life cycle of both *C. finmarchicus* and NSS herring. *C. finmarchicus* move between deep waters in winter and productive surface waters in summer. NSS herring migrate from the coast and out in the Norwegian Sea to prey on this abundant zooplankton population in summer, but return to the coast for overwintering and subsequent spawning (Fig. 2).

NSS herring is one of the world's largest fish populations. With a bioenergetics model we estimated the food consumption of NSS herring to be about 38 million tonnes wet weight (for a herring spawning stock biomass of about 6 million tonnes). The energy equivalents of this food consumption would sustain the citizens of London for six years! About 60% of the food consumption of NSS herring consists of *C. finmarchicus* (Dalpadado *et al.*, 2000; Dommasnes *et al.*, 2004), a considerable part of the annual production of *C. finmarchcicus* in the area (Aksnes and Blindheim, 1996; Skjoldal *et al.*, 2004). Because NSS herring mainly feed on the larger copepodite stages of *C. finmarchicus*, predation may have effects on the population dynamics of *C. finmarchicus*. Heavy predation by NSS herring one year may lead to a small overwintering population of *C. finmarchicus* the following winter and subsequently, low *C. finmarchicus* recruitment the next summer.

Data on body mass changes of NSS herring during the feeding migration are an important input to the bioenergetics model, and results in consumption estimates with a high temporal resolution (Varpe *et al.*, in press). The body mass increase of NSS herring is very rapid during a short period of the feeding season, from the second part of May to the first part of July (Fig. 1b). The number of large copepodites from the spring spawned generation of *C. finmarchicus* peak at the same time (Fig 1b; Østvedt, 1955), and these copepodites build large lipid stores in preparation for the deep water resting phase. These energy rich individuals are particularly valuable prey for NSS herring and may explain the rapid weight gain of NSS herring.

NSS herring does not eat whilst overwintering or before spawning. Consequently it is a pure 'capital breeder' where fecundity depends on the energy stores acquired during the previous feeding season. Therefore, eggs and milt left at the spawning grounds is a consequence of long distance transport of biomass from ocean to coast. For NSS herring, spawning leads to a reduction in body mass of about 20%, and at the population level the reproductive output left at the spawning grounds have covaried with the large fluctuations in NSS herring abundance during the last century (Fig. 1c; Varpe *et al*., in press). At times of a high NSS herring population this transport is the largest long distance transport of biomass by a single migrating population (Varpe *et al*., in press).

In contrast to many pelagic fish species, herring is a demersal spawner. This leads to concentrated deposition of the transported biomass, and consequently, food is abundant for species that can utilize herring eggs, for instance haddock, *Melanogrammus aeglefinus* (Toresen, 1991). Benthic crustaceans, such as the European lobster (*Homarus gammarus*) may also profit from this food source, and interestingly, a rapid decrease in lobster landings were observed shortly after the collapse of the NSS herring population (Fig. 1c; Varpe *et al*., in press). This suggests that some part of the life cycle of lobsters may be linked to herring eggs as a food source. Herring larvae are also important food for many coastal predators, and the reproductive success of Atlantic puffins (*Fratercula arctica*) is closely linked to the availability, as well as the quality, of first year herring (e.g. Durant *et al*., 2003).

The biomass transport from ocean to coast described above is an example of ecological processes at the scale of meta-ecosystems: *a set of ecosystems connected by spatial flows of energy, materials and organisms across ecosystem boundaries* (Loreau *et al*., 2003). Biological oceanography is ripe with examples of ecosystem couplings due to nutrients, plankton and larval fish passively drifting in ocean currents, but cases where animals are an important transporting vector between ecosystems are rare. Migration patterns are dynamic and subject to rapid changes, particularly if the migrating species is subject to strong selection pressures which may result from climate change, heavy fisheries or trophic cascades. For instance, the migration patterns of NSS herring has changed markedly at several occasions during the last century, probably as a combination of heavy fishery and learning processes (Huse *et al*., 2002). Such changes determine where resources are gathered and deposited, and therefore, how meta-ecosystems function. Ecosystem management is presently a much discussed issue in many forums, and large migrating fish stocks which link separate ecosystems are a particular challenge to this concept. The appropriate scale for many management decisions may therefore be the meta-ecosystem, and an important tool for predicting biological changes in the system will be behavioural and evolutionary ecology (Sutherland, 2005).

The study is part of the project ADAPT (GLOBEC Norway), and it is financed by the Norwegian Research Council. We thank Elin Holm for help with drawings in Figure 1. Figure 2 was originally published in Varpe *et al*. (in press) as well as the body mass data in Figure 1b and the material in Figure 1c. The figures are published here with kind permission from Springer Science and Business Media.

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Increasing the visibility of global ocean data sets through the GLOBEC Metadata Portal: NASA's Global Change Master Directory

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With the number of ocean data sets increasing each year, the need to organise, preserve, and publish these to the scientific community has become an essential part of data management. As a result, the increased visibility and access to ocean data sets has made the ability to integrate, synthesize, and share information from disparate datasets easier - often leading to important and publishable work.

Through the GLOBEC Metadata Portal, http://gcmd.gsfc.nasa.gov/portals/globec/, scientists can advertise, search and access collected data from the GLOBEC programme. The portal is also accessible via the GLOBEC website, http://www.globec.org/ by following the links to 'data' and then 'metadata portal'. The portal is hosted by NASA's Global Change Master Directory (GCMD), http://gcmd.nasa.gov, a comprehensive directory of descriptions of data sets and services of relevance to global change research. The metadata standard used is the Directory Interchange Format (DIF), http://gcmd.nasa.gov/User/difguide/, which has been adopted within the GLOBEC data policy. The data are described through a set of required, recommended, and optional metadata fields. Some are entered as free-text, others from a selection of controlled keywords. GLOBEC members are encouraged to submit metadata related to their datasets to the GCMD. This can be done easily by clicking on the "create or modify a data set description" link at http://gcmd.nasa.gov/User/authoring.html. For scientists in the field wishing to create records, the GCMD offers a stand-alone, offline metadata authoring tool. Data providers with existing metadata records in formats other than DIF can submit them for XML transformation to mmeaux@gcmd.nasa.gov.

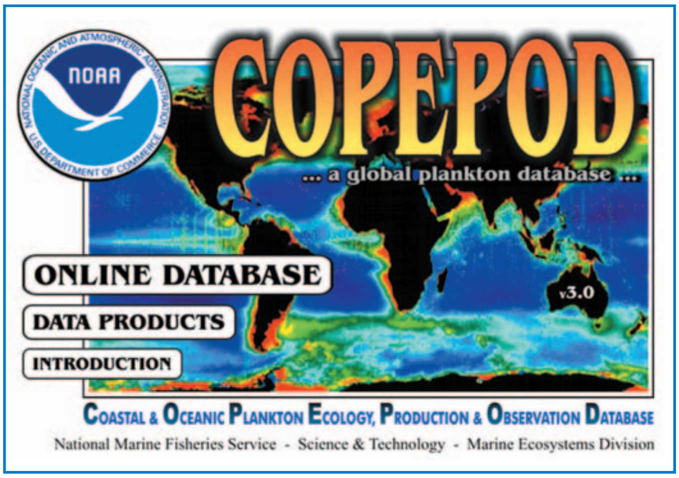
Figure 1. GLOBEC Metadata Portal

The GLOBEC Metadata Portal can be searched using a keyword search and/or a simple free text search. The keyword search is based on a hierarchical set of Earth science topics (Fig. 1), http://gcmd.nasa.gov/Resources/valids/keyword_list.html. Users may also refine a search based on location, instrument, platform, project, data center, spatial and temporal coverage.

The GLOBEC community can expand their searches beyond GLOBEC data by searching the entire GCMD database. For a complete listing of all GCMD customized portals, see: http://gcmd.nasa.gov/Data/portal_index.html

NMFS-COPEPOD: A new approach to plankton data management

Todd O'Brien, US National Marine Fisheries Service (Todd.OBrien@noaa.gov)



The *World Ocean Database Plankton* (O'Brien *et al.*, 2002; O'Brien, 2001; 1998) was an attempt to build a global plankton database by adding plankton tow data to an existing profile-based database. While the attempt was successful at some levels, the ultimate fate of most incoming plankton data was to become an anonymous point in a massive temperature and salinity database with considerable access and extraction challenges. An investigator sending plankton data to the project would often have to wait 2-3 years to see their contribution available on the next CD-ROM release, only to find it in a complex format that required significant programming and code translation to use it. Other potential users, searching for a specific plankton data type, may be misled by the generic distribution maps or the limited online search which claimed that "X tows exist" for their data query. Only after hours of programming would the investigator find that the sampling methods or exact content of those "X tows" were incompatible with their specific research needs. Clearly, this system needed some major improvements in its accessibility and content summaries.

A new beginning … a new approach

In 2004, a new plankton database effort began, incorporating over ten years of plankton data management experience into designing and building a new online plankton-specialized data

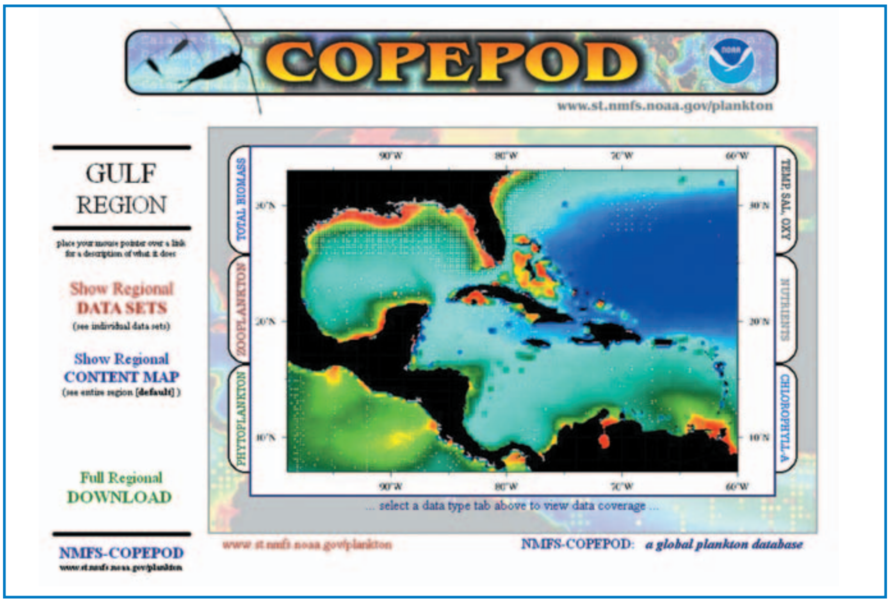


Figure 1. COPEPOD regional summary for the Gulf Region.

system. The ***C**oastal & **O**ceanic **P**lankton **E**cology, **P**roduction & **O**bservation **D**atabase* **(NMFS-COPEPOD)** contains the entire reprocessed plankton content of the previous work, plus significant amounts of new plankton data, and represents a completely new approach to providing online global-coverage plankton data to the scientific community.

NMFS-COPEPOD is designed to allow the user to easily find the exact plankton data they want, download it in a format that they can readily use, but also preserve acknowledgement to the original investigators and institutions that collected those data. To do this, COPEPOD presents data at multiple packaging levels:

The basic unit of COPEPOD is the "Data Set Summary", which is a collection of related data from a cruise, ship, sampling program, or project. Each data set summary features detailed graphical and text descriptions that list the exact contents and methods of the data therein. Each summary also gives clear credit to the associated investigators, projects and institutions responsible for collecting and compiling those data.

The next COPEPOD level is the "Regional Summary" (e.g. the Atlantic Ocean, the Gulf of Mexico, the Antarctic), which allows a user to view distribution maps of all data types available within that region and download a compilation of all data sets present in that region (Fig. 1).

Finally, comprehensive listings and master summaries allow the user to search through all data associated with a given cruise, ship, institution, project, country, taxonomic group (e.g. "copepods", "diatoms"), or investigator (Fig. 2).

New plankton data are added and made available each month on COPEPOD, and this upcoming year will also bring newly developed data-based products and compilations to its offerings. Whether you are a global biomass modeller or a regional copepod researcher, we hope that NMFS-COPEPOD will have something for you.

Making old plankton data available for new research

With several studies in the Atlantic and Pacific Oceans finding dramatic changes in the plankton communities, it is clear that having better access to historical plankton observations may help us to better understand these events. COPEPOD has an ongoing effort to uncover historical plankton manuscripts and data buried in institutional archives and libraries. These recovered documents are then keyed into electronic form through the NOAA Climatic Database Modernization Program (CDMP). After reviewing the keyed data for content, quality, and metadata completeness, COPEPOD makes these "new" old plankton data available online.

Seeking help from the community

One hundred eyes are better than two. COPEPOD invites plankton investigators to join in the search for buried historical plankton data. Check that old filing cabinet, dust off that old book shelf, dig through that old box of notebooks, and then let us know if you have or know of any plankton data forms, log books, data tables that should be keyed by COPEPOD and added to the collections. Give those old data a new life, and add your name to the COPEPOD data contributors list.

NMFS-COPEPOD is available now, online at: **http://www.st.nmfs.noaa.gov/plankton**

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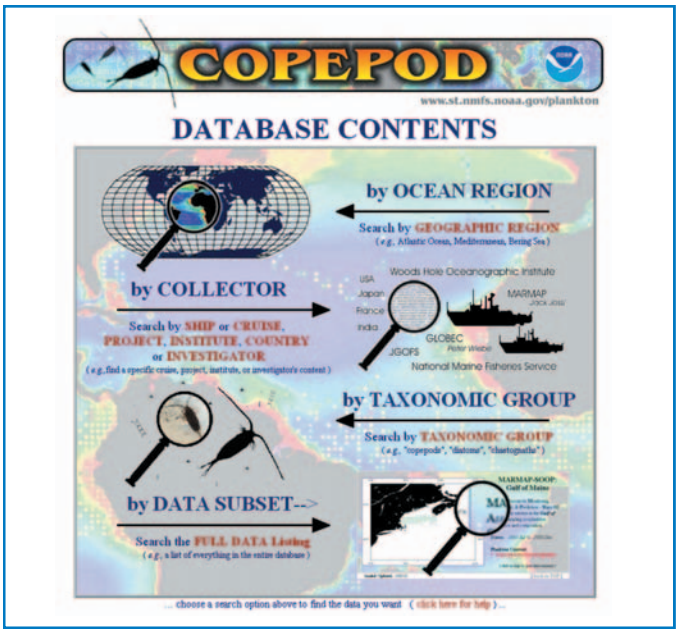

Figure 2. COPEPOD search screen.

Atlantic wide regime shift?

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The pronounced changes through time shown in the contour plots of the mean monthly Phytoplankton Colour Index (PCI) averaged for large areas of the North Sea and Northeast Atlantic and first shown in Reid *et al*. (1998) are now well known. This index is a visual estimate of chlorophyll measured on silks from the Continuous Plankton Recorder (CPR). Recent calibrations with SeaWIFS by Raitsos *et al*. (2005) and Leterme and Pingree (in press) have confirmed that the PCI is a good, if crude, measure of chlorophyll; the calibration has enabled the production of a >50 year Chl *a* time series in the central northeast Atlantic and North Sea.

Figure 1 gives an update of the figure shown in the 1998 paper, with similar plots for two areas in the western Atlantic, the Grand Banks and NE Canadian Atlantic. The observed increases in phytoplankton biomass and extension of the growing season that occurred around the mid 1980s in the North Sea and in the Atlantic to the west of the British Isles have continued, a pattern that has also been followed in the sub boreal gyre south of Iceland in the northern northeast Atlantic from 1998. A similar extension in the growing season, but with a different seasonal cycle has also been seen in the western Atlantic. Unfortunately, because of a lack of sampling between the years 1976 to 1991 the timing of the change prior to 1990 and post 1980 is not known. However, a number of other changes in the northwest Atlantic (Brian Petrie, pers. comm.), including the catastrophic decline in the cod stocks and increases in northern shrimp (Worm and Myers, 2003) occurred at this time. They showed that cod biomass was positively related to temperature, but attributed the inverse relationship of cod and shrimp to top down predator control.

The timing of the changes in the northeast Atlantic are part of the North Sea regime shift first noted by Reid *et al*. (2001) and subsequently analysed by Beaugrand (2004) and shown to be related to changes in large-scale hydro-meteorological forcing (temperature and wind intensity and direction and associated changes in the position of oceanic biogeographic boundaries). These events reflect a pronounced change in climate shown especially in the

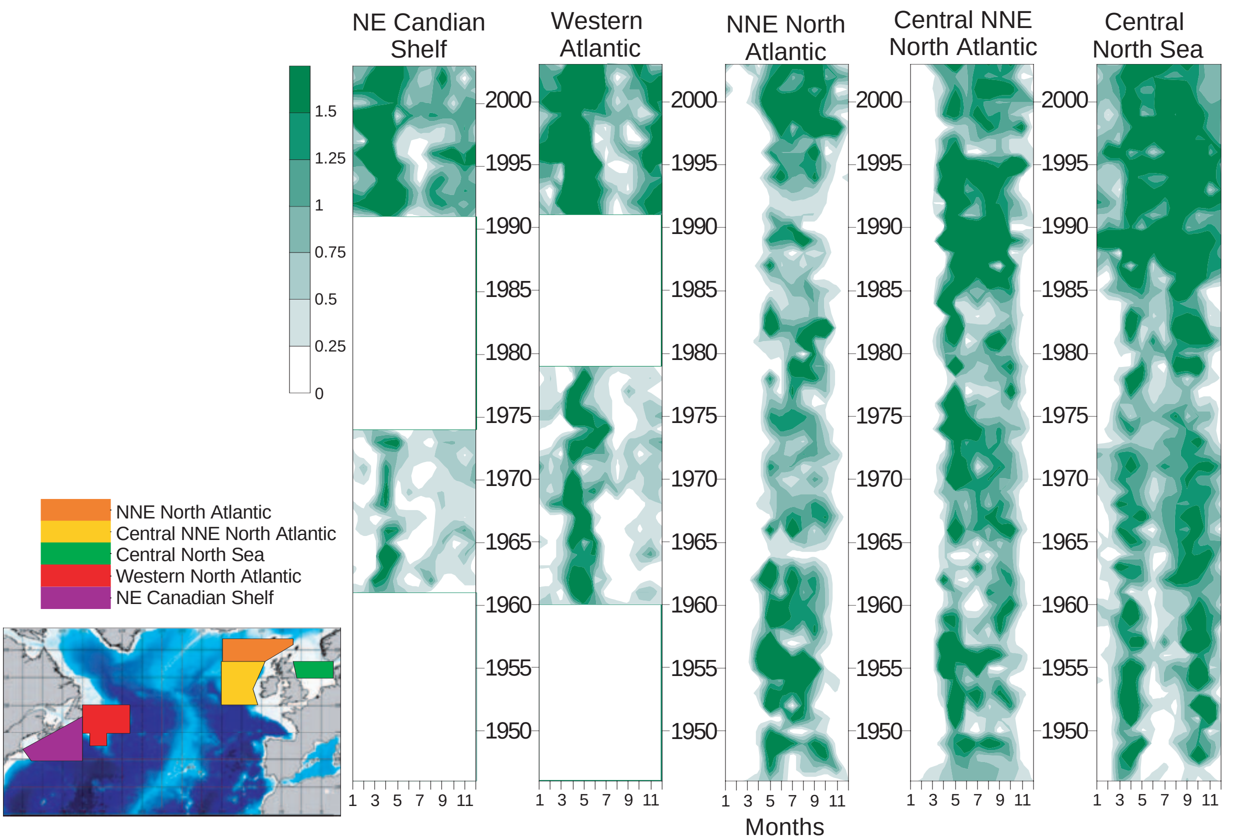

Figure 1. Contour plots of mean monthly Phytoplankton Colour for the NE Canadian Shelf, Western Atlantic, NNE North Atlantic, Central NNE North Atlantic and Central North Sea.

high correlations with Northern Hemisphere temperature. Yasunaka and Hanawa (2002) showed that a regime shift occurred in Northern Hemisphere sea surface temperature fields in 1988/89 coinciding with the changes noted here and that sea surface temperatures averaged for the whole of the North Atlantic showed a similar step wise change to the PCI in the mid 1980s. The evidence suggests that the coincidence of the timing of the changes in cod, shrimp and other variables and especially lower salinities in the northwest Atlantic, as well as evidence for a marked increase in the occurrence of Arctic plankton in this region (Johns *et al.*, 2003) indicates that the regime shift may well be a North Atlantic wide phenomenon.

The changes in Phytoplankton Colour are in essence the same, other than for seasonal differences on both sides of the Atlantic, but occur under contrasting conditions; in the east sea surface temperatures have risen substantially (~0.5°C in the North Sea) over the last few decades whereas salinities have reduced in the western Atlantic region. The latter likely reflecting increased outflow of meltwater from the Arctic. The increases seen since 1998 in the area to the south of Iceland coincide with a return to higher sea surface temperatures after a long period of cooler temperatures since the late 1960s (although this does not explain the considerable relative increase in Colour).

The North Atlantic plays a key role in the meridional overturning circulation, as a reservoir for heat and as a depository for CO_2. Changes of the scale described here are likely to have important consequences for the biological pump and for atmospheric concentrations of CO_2. Because similar programmes to the North Atlantic CPR survey that measure phytoplankton changes for chlorophyll and species composition do not operate in other ocean regions we have no idea if similar changes are taking place elsewhere in the world. There is an urgent need to develop and fund ocean monitoring systems within GOOS and especially to initiate and maintain long-term basin-scale CPR programmes outside the North Atlantic.

I wish to make five points:

- Substantial changes have taken place in ecosystems across the northern North Atlantic circa the late 1980s that have had marked impacts on marine ecosystems and living marine resources.
- The changes in Phytoplankton Colour in contrasting hydrodynamic conditions are difficult to explain. Possible links with increased concentrations of CO_2 in seawater need to be investigated, although this is an unlikely cause.
- Pronounced changes in the circulation of the North Atlantic, especially outflow from the Arctic and in the eastern boundary current may be associated with these events.
- The links with Northern Hemisphere temperature and via this to greenhouse gases (see IPCC) indicate that global warming may be impacting the North Atlantic more rapidly than previously thought possible.
- There is an urgent need to increase the speed of implementation of GOOS and especially to start up long-term plankton monitoring programmes analagous to the CPR survey. If the same standardised and well proven CPR methodology is used inter-ocean comparions will be possible.

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International Conference: The Humboldt Current System: Climate, ocean dynamics, ecosystem processes, and fisheries

Lima, Peru, November 27 - December 1, 2006

Scope of the Conference

The ocean off the west coast of South America is notable for several reasons. First, it produces more fish per unit area than any other region in the world oceans. Second, it is an area of low oxygen and intense denitrification contributing significantly to global budgets. Third, it is intimately linked to the ocean-atmosphere coupling over the tropical Pacific, and therefore subject to large year-to-year and decade-to-decade fluctuations in regional ocean climate. Finally, these processes have combined to preserve a detailed ecosystem history in the sediments over the past millennium and beyond.

An outstanding synthesis on the dynamics of the Peruvian Upwelling System was produced by IMARPE in conjunction with ICLARM (now World Fish Center) and the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) during the mid 1980s and published as conference proceedings in 1987 and 1989. These efforts continue to serve as major references for the Humboldt Current System (HCS).

Since the 1980s, important technical and conceptual advances have transformed many areas of marine science. These changes provide a new background to re-examine the question surrounding the linkages between climate, ocean circulation, biogeochemical cycles and fish production. For example, are the ecological disturbances associated with large interannual to multidecadal climate fluctuations one of the factors somehow responsible for the overall high levels of long-term fish production? New observing capabilities, data synthesis and analysis, and improved ocean mapping and modelling tools can now provide a view of the dynamics of the HCS ecosystem within a multidisciplinary context.

Operational fisheries management is also evolving away from a monospecific to an "ecosystem-based" paradigm. This new approach, likely to be embraced in the 21st century, appears to be particularly appropriate for the HCS, where the uncertainty associated with decadal variability and regime shifts represent major challenges for ecology and fisheries research.

There is clearly a need, and an opportunity now, to undertake a new integration and synthesis to advance our understanding of the Humboldt Current System. The challenges include synthesis of available data, application of improved numerical models and integration across disciplines and habitats. The objectives of this Conference are to initiate this new regional integration and synthesis and to foster exchanges among regional and international experts. Contributions that update the early synthesis with work done in the region during the last two decades are especially encouraged as are modelling and integrative efforts.

Similar syntheses from other eastern boundary systems are invited, especially if they are carried out within a comparative framework. New observations and conceptual models are also encouraged.

The Conference will include the following main topics:

- Intra-annual to inter-annual, multi-decadal to centennial-scale variability in the Humboldt Current System within an integrated framework.
- Climate and ocean dynamics, and biogeochemical cycles.
- Lagrangian processes, plankton dynamics and larval survival of fish resources.
- From phytoplankton to apex predator and fishers, and back: trophic controls and predator-prey relationships.
- Adaptive strategies of fish and other key species in a highly variable ecosystem: biology, spatial distribution and behavioural ecology.
- Adaptive management: integrating multi-scale and multi-parameter processes within the context of environmental uncertainty.

Special consideration in the selection of oral versus poster presentations will be given to papers dealing with a multidisciplinary or integrated approach, including comparative studies between areas and populations inside the Humboldt Current System.

Steering Committee

Arnaud Bertrand, IRD, France (co-convener)

Renato Guevara, IMARPE, Peru (co-convener)

Pierre Soler, IRD, France (co-convener)

Wolf Arntz, AWI, Germany

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For further information:

HCS International Conference, c/o Representación IRD en el Perú, Casilla 18-1209, Lima 18, Perú.
E-mail : hcsconference@amauta.rcp.net.pe

From IDYLE to ECO-UP

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IDYLE was a joint programme between IRD (Institut de Recherche pour le Développement, France) and mainly two South African institutions (Marine and Coastal Management; University of Cape Town), plus a number of national (Namibia, Angola) and regional bodies (BENEFIT, BCLME) from the Benguela Current ecosystem. This programme ended in December 2004 but a new programme, named ECO-UP, is born from IDYLE and the part of another IRD-managed programme (ACTIVE, directed by F. Gerlotto) aimed at eco-ethological studies in the Humboldt Current ecosystem. Furthermore, ECOP-UP incorporates a third upwelling ecosystem: the Canary Current.

ECO-UP stands for "Ecosystèmes d'Upwelling" and its full title is: "Structure and functioning of exploited upwelling ecosystems: comparative analyses within the framework of an ecosystem approach to fisheries". It is a 4 year programme (2005-2008) directed by Dr Pierre Fréon with the help of Dr Christian Mullon for scientific coordination. It involves, at different degrees, scientists from the following countries belonging to the three above-mentioned ecosystems:

- Benguela: Angola, Namibia, South Africa (ecosystem leaders: L. Drapeau and L. Shannon)
- Canary: Mauritania, Morocco, Senegal (ecosystem leader: E. Machu)
- Humboldt: Chile, Peru (ecosystem leader: A. Bertrand)

The programme develops strong links with French (PNEC, LEGOS, LOCEAN, LPO, GEODES, Ifremer, US 025, ACAPELLA, CHRONOS, ESPACE, OSIRIS), regional (BENEFIT, BCLME, CCLME, etc.) and international partnership (GLOBEC-SPACC, EUR-OCEANS, SCOR-IOC, etc.).

The upwelling ecosystems provide over 40% of the world catch but yet represent less than 3% of the world ocean surface. They are characterised by a high variability, linked to global climate change as well as their structural instability. Today, they are subject to the effects of climatic fluctuations and those of reorganisation of the world fisheries, which can induce some important changes in the ecosystems themselves.

The aim of the Research Unit ECO-UP is to provide an adapted methodology to analyse the structure and functioning of upwelling ecosystems in order to implement an ecosystem approach to fisheries.

By using in these ecosystems an integrative and comparative approach (Fig. 1), we will study, at various spatial scales, the dynamic of the pelagic fish and their ecosystem, in relation with their exploitation and the global and regional changes of the environment. With this approach and by using special tools to represent the spatial and temporal dynamics and their interactions, we are thus asking fundamental ecological questions, leading to practical management applications.

We will especially focus on the following questions:

- global change and its local incidence in upwelling areas;
- exploitation and its effects on the structure and functioning of the upwelling ecosystems: spatial interactions between marines resources and the physical environment, adaptive strategies of the populations and communities;

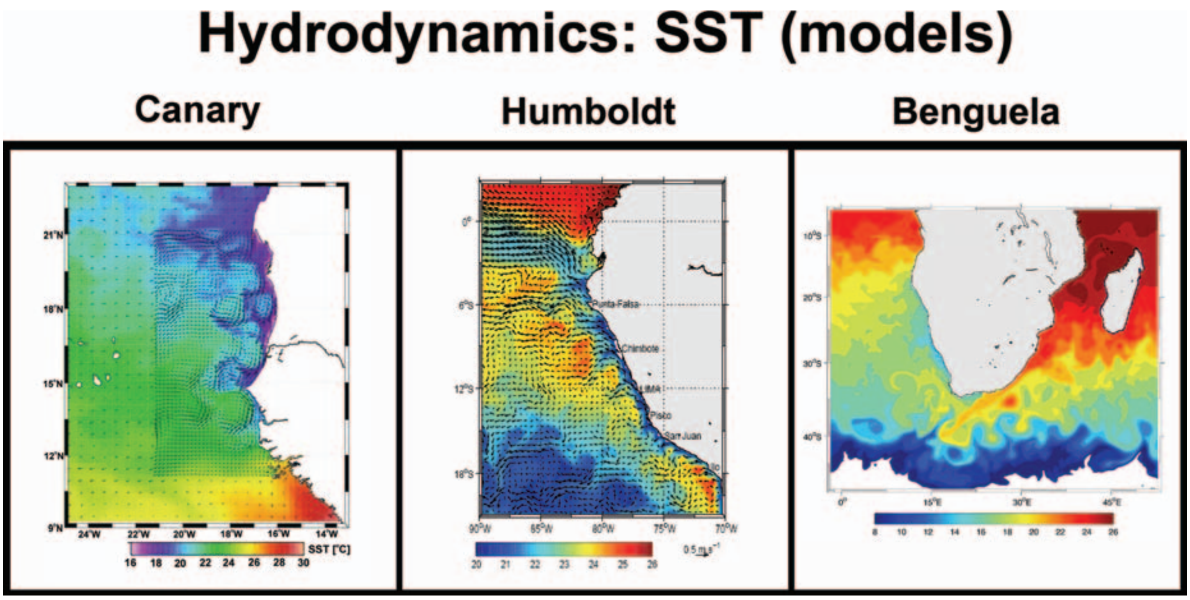

Figure 1. Example of the comparative atlas. The programme will produce a series of such figures, comparing environmental and biological parameters or models from the three upwelling ecosystems with relevant comments identifying the differences and similarities between system and the corresponding lessons.

- regime shifts in upwelling ecosystems;
- socio-economical aspects of the pelagic fisheries in the world.

The methods that we will develop, use and integrate will include:

- analysis and modelling of the physical (hydrodynamic) processes which are essential to the dynamics of biological processes such as primary and secondary production, recruitment and distribution of resources;
- Lagrangian approaches (tracking particles in current fields provided by the hydrodynamic models) to analyse the links between the physical environment and the various upper trophic levels;
- tropho-dynamic models to analyse the spatio-temporal dynamics of species interactions in the ecosystem;
- geographic information systems (GIS) and ecosystem indices to incorporate all the available knowledge within one or two ecosystems; *in situ* experiments which enable the identification of how space is utilised by pelagic species as a function of their biology and the environment *sensu lato*.

A strong partnership is essential for this project and a great significance will be given to:

- the transfer of knowledge to countries involved in this partnership and to all the scientific community;
- the support of the implementation of precautionary management based on indicators calculated using data from ongoing surveys of the communities (exploited and unexploited) taking into account the global context (annual and decadal variability);
- the training of young researchers and students from countries associated with this project (South Africa, Namibia and Angola; Chile and Peru; Morocco, Mauritania and Senegal) in various fields such as modelling, collection and analysis of data, information systems, satellite remote sensing and environmental assessment.

A GLOBEC Focus 2 Symposium at the Sixth International Crustacean Congress

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The 6th International Crustacean Congress, held 18th to 22nd July 2005, proved to be an ideal venue for a GLOBEC Focus 2 symposium on the adaptations of pelagic fauna to environmental variability. Although the subject animals were restricted to Crustacea, a diverse range ecophysiological and behavioural themes were addressed. Many of the talks focused on krill and the reasons behind their prominence in the ecosystems of many regions, especially those at high latitudes. Adaptive mechanisms in copepods and isopods were also considered.

Oral presenters at the pelagic session of the ICC6 Ecophysiology Symposium, from left to right: Magnus Johnson, Fred Buchholz, Nancy Marcus, Konrad Wiese, Katrin Schmidt, Geraint Tarling, Reinhard Saborowski.

In his keynote talk, Fred Buchholz (Alfred Wegener Institute for Polar and Marine Research) posited that the plasticity of krill in terms of growth, reproduction and metabolic rates is key to their success. Parallels were drawn between the adaptive capabilities of polar species *(Meganyctiphanes norvegica* and *Euphausia superba)* and a sub-tropical counterpart *(E. hanseni).* All have high swimming velocities that allow them to exploit patchy food environments optimally while their ability to alter physiological rates enables them to adapt to extreme periodicity in food supply. The synchronization of behavioural traits (e.g. vertical migration) and physiological processes (moulting cycles and spawning periods) between individuals may also be fundamental to their ecological success.

Konrad Wiese (Universität Hamburg) continued the theme of synchronization through examining means by which krill species may communicate with each other. A series of ingenious experiments, designed to examine the reaction of krill to both light and mechanosensory stimuli, were described. One surprising finding was the ability of krill to match pleopod beat rate of their immediate neighbours, so ensuring that all beat to the same rhythm. Magnus Johnson (University of Hull) measured the swimming performance of tethered krill and found that moult stage and maturity affected swimming strength. Interestingly, he also found that krill with full stomachs rested significantly more than starved counterparts, meaning that they probably sank rapidly when satiated.

Krill feeding was continued in two further presentations. Reinhard Saborowski (Alfred Wegener Institute for Polar and Marine Research) considered the differences between the feeding enzymes of Antarctic and Northern krill and determined that the former has a greater diversity of enzymes, which makes it more able to cope when principal food items are in short supply. Katrin Schmidt (British Antarctic Survey) illustrated how diverse the diet of Antarctic krill can be, which may explain why this species can continue to grow even when food availability is low.

Nancy Marcus (Florida State University) considered the effects of hypoxia on the copepod *Acartia tonsa*. Hypoxia lowers egg production but many species limit exposure through migrating in and out of these layers, mainly on a diel basis. The timing of exposure is important because those encountering hypoxia during just the dark period fare as badly as those exposed to hypoxic conditions for the whole 24 hours. Hypoxia was also implicated in the study of Karen Osborn (Monterey Bay Aquarium Research Institute) when examining the distributional limits of the holopelagic isopod *Acantha-munnopsis milleri*. The presentation fascinated the audience with its beautiful *in situ* images of the species captured on video by ROVs. Over 10 years worth of video observations were synthesized to generate the data set.

The wide variety of other symposia at the congress, such as Phylogeny, Invasive Species, Mating Systems and Diseases, meant that it provided a well-rounded educational experience for all. The city of Glasgow (UK) proved to be a popular setting with its friendly bar culture. All agreed that the meeting ran smoothly from start to finish thanks to the efficient organisation of Douglas Neil (University of Glasgow). A themed issue of Journal of Plankton Research containing some of the mentioned presentations is planned for 2006.

GLOBEC Symposium on Climate Variability and Sub-Arctic Marine Ecosystems

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From 16 to 20 May 2005, approximately 220 scientists from 16 countries enjoyed warm Canadian hospitality in Victoria, British Columbia, while attending the GLOBEC-sponsored symposium, Climate Variability and Sub-Arctic Marine Ecosystems. As a start to the new GLOBEC regional program, Ecosystem Studies of Sub-Arctic Seas (ESSAS), GLOBEC, with the help of the North Pacific Marine Science Organization (PICES), organized an international symposium and open Implementation Workshops for both ESSAS, and its United States component, the Bering Ecosystem Study (BEST). The overarching scientific objective of the symposium was to present current knowledge of the effects of spatial (regional) and temporal (seasonal to multi-decadal) climate variability on the structure and function of Sub-Arctic marine ecosystems. The workshops presented the ESSAS and BEST implementation plans to seek input from the broader scientific community.

The Sub-Arctic seas support substantial fish stocks, which generate a major portion of the commercial landings of the surrounding nations and provide critical resources for subsistence fishers and vast numbers of marine birds and mammals. Several physical and biological factors make these seas unique: seasonal ice cover, large quantities of freshwater from ice-melt and runoff, dramatic seasonality, reduced sunlight, and low biodiversity. Because these areas are expected to undergo the largest climate-forced changes outside of the high Arctic, climate change is expected to have major economic and societal impacts in these systems. Thus the research programs of ESSAS and BEST, both of which are focused on how climate variability will affect the sustainability of sub-arctic marine ecosystems, are timely and of societal importance. The week of workshops and scientific presentations in Victoria set the stage for the start of these programs.

As sea ice cover disappears, marine mammals dependent on this habitat will have to retreat northward, thereby reducing their availability to subsistence hunters. Photo by Captain Budd Christman, NOAA Corps. Bering Sea, June 1978.

The Victoria meeting began on Monday (16 May) with a one-day BEST workshop attended by 132 scientists. The workshop commenced with short presentations by agencies and groups concerned not only with resource management and coordination of research, but also with the subsistence and commercial harvest of Bering Sea resources. The workshop examined the BEST implementation plan, and provided a forum for lively discussions of the goals and priorities of the program. Key discussions focused on how to design and implement a program capable of linking the effects of climate change on lower trophic levels to impacts on upper-trophic-level organisms, including fish, seabirds, marine mammals, and people. BEST activities will place a strong emphasis on the human dimension, including the potential impacts of physical and ecosystem changes on the people and cultures dependent on subsistence and commercial uses of Bering Sea resources (Fig. 1).

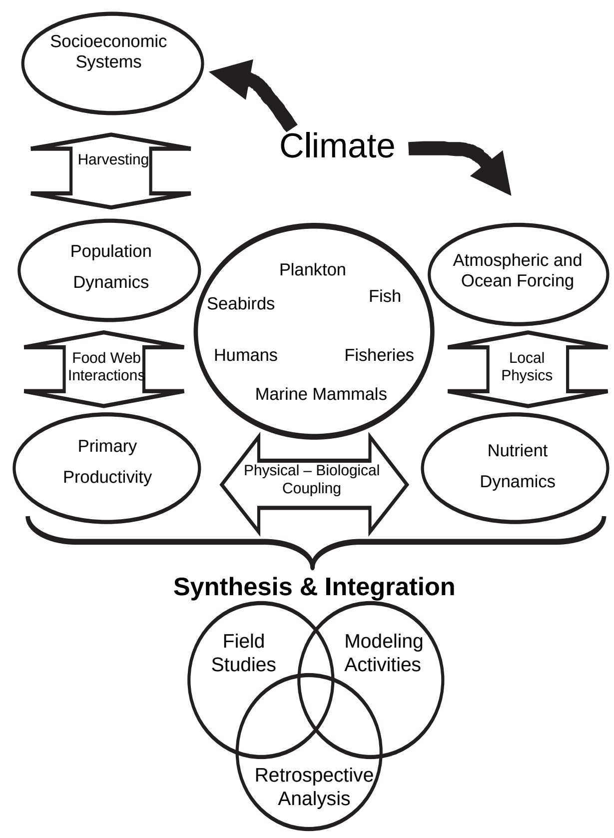

Figure 1. Diagram of the end-to-end approach and integrated activities to study the Sub-Arctic marine ecosystems, food webs and social systems. Modified from the BEST Implementation Plan, available at http://www.arcus.org/Bering/Downloads/BEST_IP_23_JUNE.pdf.

After the workshop, there was a splendid reception for all symposium and workshop participants in the First Nations section of the Royal British Columbia Museum. This reception afforded participants the opportunity for informal visiting among a spectacular collection of artefacts from the civilizations that have lived along the shores of the Pacific Northwest coast of North America.

Ken Drinkwater, Cisco Werner and Keith Brander at the reception in the Royal British Columbia Provincial Museum First Nations Hall.

The BEST workshop was followed by the 3 day symposium consisting of 69 oral presentations and 105 posters. The oral presentations began with a keynote talk by Richard Barber (USA) on how ocean warming in the next 50 years will affect Sub-Arctic marine ecosystems. Based on the output of six coupled climate ocean models with identical CO_2 forcing, the results suggested increased primary production levels in the Sub-Arctic and Arctic regions, which will be offset by reductions in the tropical and temperate oceans, for little to no net change globally. Regional reviews on the physical oceanography and biology of 6 major Sub-Arctic regions (Barents/Norwegian Sea, Iceland, Labrador/Newfoundland, Bering Sea, Sea of Okhotsk, and Oyashio Current) and the Antarctic were then given to provide background information and highlight similarities and differences between regions. A panel discussion followed to focus attention on what and how comparisons should be undertaken.

The second and third days of the symposium were taken up with plenary theme sessions addressing the major expected biological responses in the water column to physical forcing, which included how will climate warming impact trophic coupling and cascades, and what have been some of the recent climate-related changes in ecosystem structure or function. In addition, Wednesday (18 May) afternoon was spent on 4 disciplinary parallel sessions on: physics and chemistry; primary production; secondary production; and fish, shellfish, marine birds and mammals. The final theme session of the symposium dealt with the human dimensions of climate variability in the Sub-Arctic regions. Sociologists, native leaders, archaeologists, and geographers discussed the socio-economic impacts of climate at time scales of a few years to changes documented in middens spanning thousands of years.

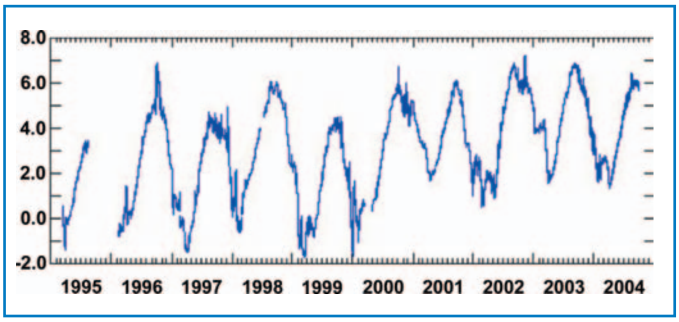

Figure 2. Vertically averaged temperature at a mooring in the middle domain of the southeastern Bering Sea. Note warming since 1999. Image courtesy of Phyllis Stabeno, Pacific Marine Environmental Laboratory, NOAA, Seattle, WA.

While it is impossible to highlight all of the discussions and results, it is clear that strong warming of air and water temperatures has taken place (e.g. the Bering Sea, Fig. 2), with subsequent reductions in the extent of sea ice in most Sub-Arctic seas, the notable cooling of the Sea of Okhotsk being an exception. Moreover, the large-scale atmospheric forcing of the Sub-Arctic regions can account for the regional patterns of the responses across widely separated Sub-Arctic seas. In particular, physical and biological data suggest a direct influence of the Pacific Ocean on the North Atlantic Sub-Arctic regions. In former periods of regional warming,

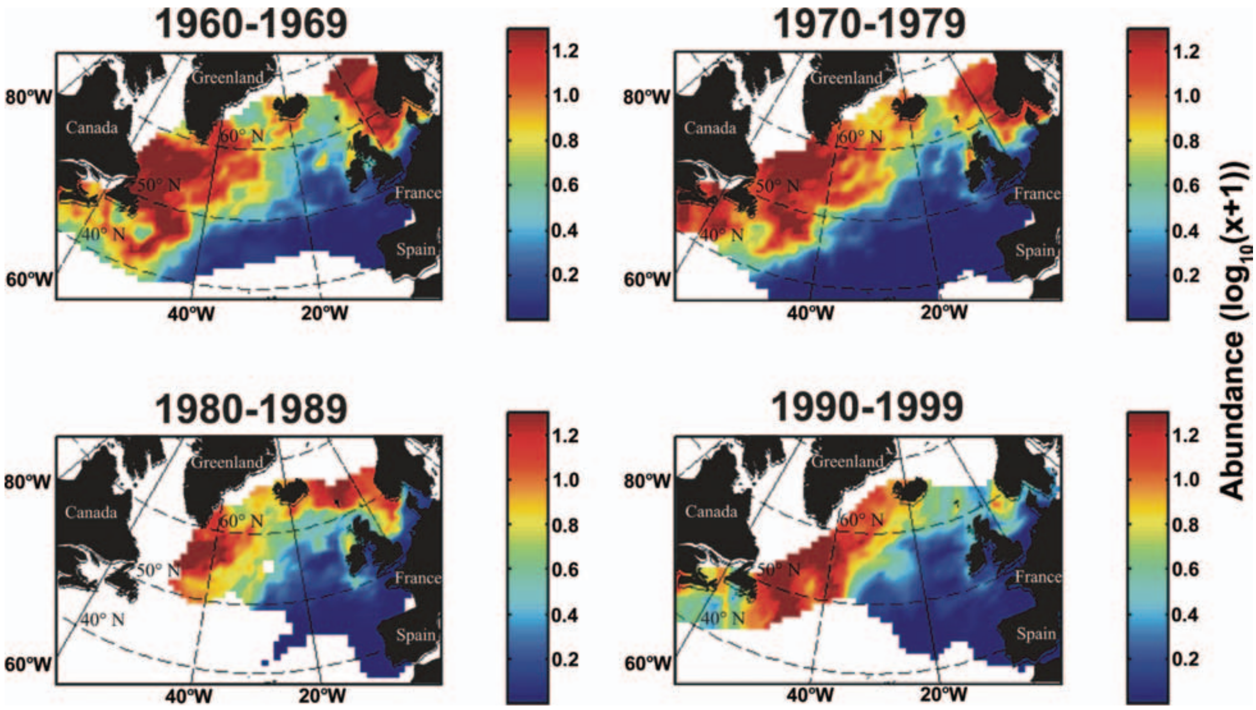

Figure 3. Changes in the distribution and abundance of the copepod Calanus finmarchicus in the North Atlantic. Image courtesy of Gregory Beaugrand, SAHFOS, UK modified from Beaugrand et al., Science 296, 1692-1694, 2002.

northward shifts in the distribution of several plankton and fish species, and earlier spring and later autumn migrations of fish were observed. In recent decades, several components of Sub-Arctic Sea ecosystems have shown unexpected shifts in abundance or distribution that, in many cases, correlated with physical changes. Among these changes are blooms of coccolithophores in the Bering Sea, changes in the distribution, species composition and abundance of gelatinous and crustacean zooplankton (Fig. 3), die offs of marine birds, and changes in the distribution and abundance of marine birds and mammals.

The high spatial and inter-annual variability of the Sub-Arctic Seas provides the opportunity to use short-term (inter-annual) fluctuations as a proxy for studying ecosystem responses at longer (decadal) time scales. Biophysical models have made significant strides during the past 5 to 10 years in their ability to simulate the observations, and offer great potential to improve our understanding and predict future changes within the lifetime of the ESSAS program. Understanding the underlying processes responsible for ecosystem responses is the basis for providing good stewardship as these dynamic regions evolve.

With this background, ESSAS has the objective to compare, quantify, and predict the impact of climatic variability and global change on the productivity and sustainability of Sub-Arctic marine ecosystems. Improved insights into the role of climate variability on Sub-Arctic marine ecosystems will be sought through comparative studies across the Sub-Arctic regions (e.g. Barents/Norwegian Sea, Iceland, Greenland, Labrador/Newfoundland, Gulf of St. Lawrence, Hudson Bay, Bering Sea, Sea of Okhotsk and Oyashio Current). ESSAS will undertake retrospective studies, modelling, and field activities in conjunction with the national components. Additionally, ESSAS will help assemble an integrated field program for the International Polar Year (IPY).

A panel discussion at the end of the presentations and reflections by Victor Smetacek (Germany) highlighted several important points. While it is clear from the work presented that climate variability affects the Sub-Arctic sea, it is also equally clear that industrial fisheries have played a major role in the restructuring of the these marine ecosystems. One major challenge to ESSAS and the scientific community will be to develop a better understanding of the ecosystem responses to climate forcing, and to evaluate how these natural forcing factors interact with anthropogenic impacts (activities) to produce the changes that we observe. Another major challenge is to make the results of the research understandable and relevant to the communities affected, including fisheries managers.

The last day of the meeting (20 May) was taken up with a workshop to discuss implementation of ESSAS. Eighty-eight enthusiastic participants heard from national representatives on various Sub-Arctic ecosystem studies, and how they might fit into the ESSAS program. Break-out groups in the afternoon provided suggestions on how ESSAS should approach the comparison between Sub-Arctic regions, and what topics should be given priority. Their ideas will help to formulate the way forward for ESSAS.

Arrangements have been made to publish about 45 papers from the Symposium in a quadruple volume of *Progress in Oceanography*. Guest editors for the volume will be Ken Drinkwater, George Hunt, David Mackas and Skip McKinnell. Manuscripts were due 15 September 2005, and it is hoped to have the volume published by late 2006. To read more about the workshop results and the BEST and ESSAS Implementation Plans, please consul the references listed below (Box 1).

As convenors, we were delighted with the high quality science and the excellent presentations. The enthusiasm for the programs, and the congenial nature of the participants added greatly to the events of the week. We wish to thank all those who participated, and in particular the invited speakers, and the panellists. We send a special thanks to the many co-sponsors, and the GLOBEC and PICES offices for their dedication and help in making the meeting a great success.

Box 1. Additional reading

Conference Abstracts:
http://www.pml.ac.uk/globec/structure/regional/essas/symposium/abstracts_book_web.pdf

Conference Presentations:
http://www.pml.ac.uk/globec/structure/regional/essas/symposium/presentations.htm

ESSAS Science Plan:
http://www.pml.ac.uk/globec/structure/regional/essas/essas.htm

ESSAS Implementation Workshop Report:
http://www.pml.ac.uk/globec/structure/regional/essas/implementation.htm

BEST Science Plan:
http://www.arcus.org/Bering/science_plan.html

BEST Implementation Plan:
http://www.arcus.org/Bering/Downloads/BEST_IP_23_JUNE.pdf

BEST Implementation Workshop Report:
http://www.arcus.org/Bering/oiw/best_workshop_05.html

GLOBEC SCIENCE

A column for scientific notes of relevance to the GLOBEC community

An eastward shift in the distribution of southern Benguela sardine

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The southern Benguela sardine (*Sardinops sagax*) population has shown a steady increase in size over recent decades, with consequent increases in catches that are now at similar levels to those attained during the early 1960s when landings of this species peaked (Fig. 1a). This increase in population size may have arisen from a conservative management policy that resulted in relatively low fishing mortality on sardine during the 1980s and 1990s (De Oliveira *et al.,* 1998). It may also have been a consequence of the persistence of suitable environmental conditions that favoured sustained sardine population growth, given the decadal-scale cycles in abundance exhibited by sardine populations elsewhere (Schwartzlose *et al.*, 1999) that appear to be linked to low frequency environmental variability.

Sardine have been caught primarily off South Africa's west and southwest coasts (Fig. 1b) during the 60 years that the purse-seine fishery has targeted this species. In the 1950s and early 1960s catches were made in the vicinity of St Helena Bay, and the infrastructure (harbours and processing factories) associated with the development of the pelagic fishery was rapidly established in that area. The fishing grounds expanded southwards and eastwards around Cape Point to Cape Agulhas throughout the 1960s and early 1970s (Crawford, 1981), and by the early 1990s sardine catches over the Western Agulhas Bank (WAB) were comparable with those made off the west coast (Roel *et al.*, 1994). The majority of sardine was caught between Lamberts Bay and Cape Agulhas during the period 1987-1998 (Fig. 2). This change in the distribution of fishing effort likely reflects declines in sardine abundance and/or availability off the west coast, a situation that has recently become more acute. Since 1997 there has been a progressive eastward shift in the center of gravity (*CoG* - the mean location of catches) of directed sardine catches (Fig. 3), caused by a decline in catches made off the west coast and an increase in catches made off the south coast (from Cape Point to Port Alfred; see Fig. 1) and landed at Mossel Bay and Port Elizabeth. Currently, a considerable proportion of sardine landed at Mossel Bay on the south coast is transported by road to the processing plants located on the west coast in the vicinity of St Helena Bay (see Fig. 1b).

Hydro-acoustic surveys conducted over the South African continental shelf every November (early summer) since 1984 also indicate a major shift in the distribution of sardine, particularly in recent years. The area west of Cape Agulhas (which incorporates the west coast, the southwest coast and the WAB) contained the bulk of the sardine biomass during the 1980s and early 1990s (Barange *et al.*, 1999). Although a gradual increase in the proportion of sardine in the area east of Cape Agulhas has been noted since 1995,

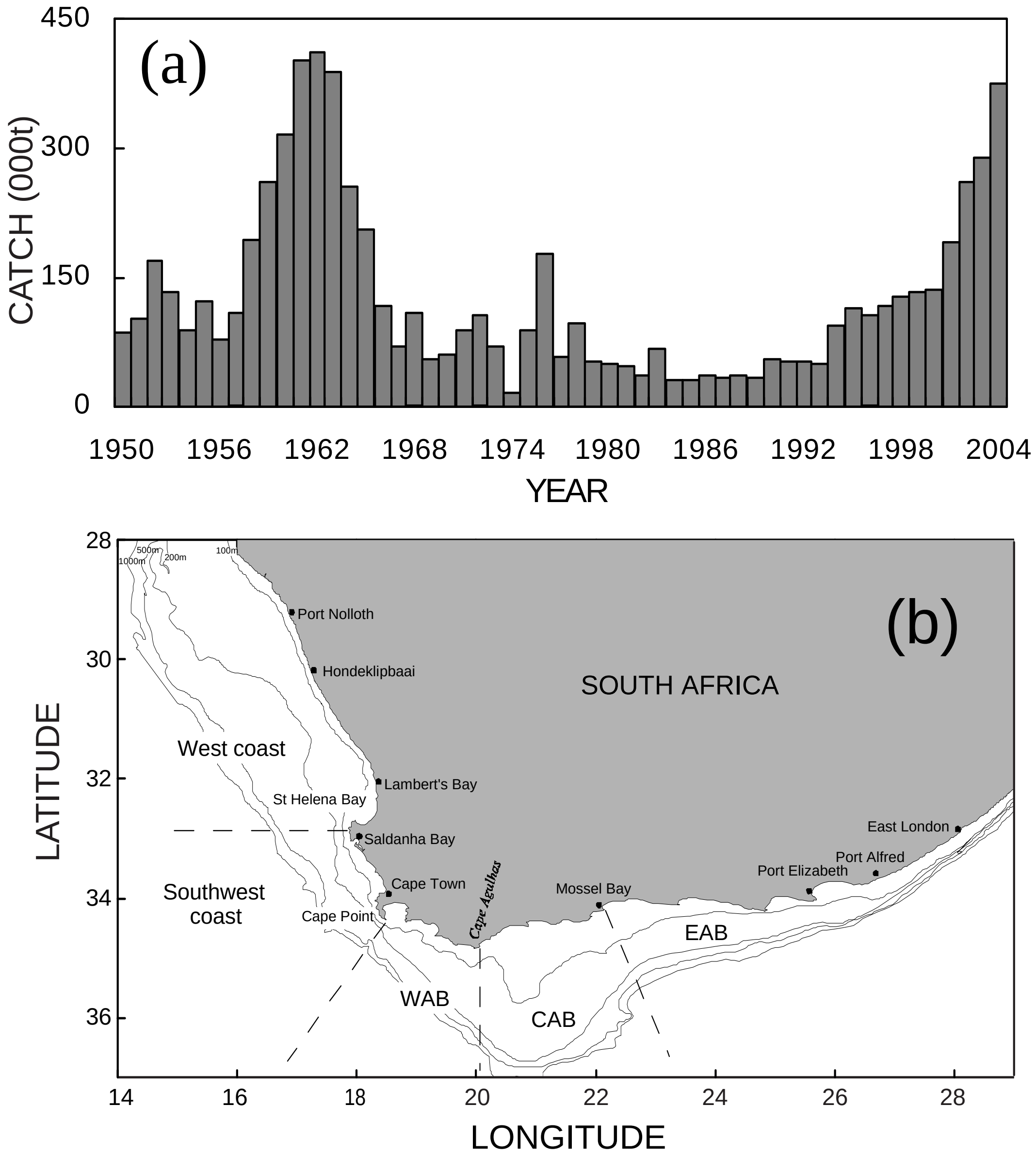

Figure 1. (a) Time-series of catches of southern Benguela sardine, 1950-2004 (total catches are shown, comprising landings from both directed fishing on sardine and sardine by-catch taken in anchovy-directed fishing operations [by-catch has ranged from 2-50% of total catch]); and (b) map of South Africa showing the location of places mentioned in the text.

the majority of sardine were located on the WAB up to 1999, when for the first time since the inception of the acoustic survey program sardine biomass east of Cape Agulhas exceeded that to the west. An interpolated surface plot of the biomass calculated per degree of longitude between Lambert's Bay on the west coast and Port Alfred on the south coast clearly indicates an increase in the importance of the area east of Cape Agulhas for sardine since 1996 (Fig. 4). Sardine found on the south coast of South Africa has formed the bulk of the biomass since 1999 and regularly comprised more than 60% of the total biomass. In November 2004, for the first time, not a single sardine was found west of Cape Point, and the few sardine still found west of Cape Agulhas were mainly recruits or 1 year old fish; the majority (>80%) of the adult population was found offshore off Mossel Bay and further east.

Ichthyoplankton samples collected during November acoustic surveys using a CalVET net have indicated shifts in the location of sardine spawning habitat, with both the west coast and the south coasts being major spawning grounds in different periods (van der Lingen *et al.*, 2001). From 1984-86, and again from 1989-1993, the majority of sardine eggs observed during November surveys were found east of Cape Point over the Agulhas Bank (Fig. 5). In 1987, 1988, and from 1994 to 2000, intense spawning was observed off the west coast, but sardine reverted to spawning off the south coast in 2001. In 2000, 23% of the estimated total abundance of sardine eggs was found to the east of Cape Point, but this increased markedly to 85% in 2001. Spawning off the south coast in early summer, more specifically along the shelf-edge of the CAB and EAB, has persisted since 2001 (Fig. 5), and in 2004 not a single sardine egg was collected west of Cape Point.

Data from three independent sources (catches and catch location; acoustic estimation of fish abundance and distribution; and CalVET net sampling to assess egg abundance and distribution) indicate an eastward shift in the southern Benguela sardine population. However, whereas the eastward shift in distribution could be attributed to an expansion in the area occupied arising from increased population size (see Fig. 1a), the relationship between biomass and area occupied is not very strong (J. Coetzee, unpublished data) and begs the question as to why the distribution has expanded only eastward and not westward as well. Sardine populations in the Pacific have shown an increase in offshore spawning grounds at high levels of abundance (Wada and Kashiwai, 1991 for Far Eastern sardine; MacCall, 2002 for Pacific sardine), and the eastward shift in sardine distribution and increased spawning offshore on the Agulhas Bank may reflect a similar sort of adaptive response. Interestingly, anchovy (*Engraulis encrasicolus*) also appear to have shown an eastward shift in spawning habitat over the Agulhas Bank in recent years, with the CAB and EAB becoming relatively more important since 1997 (van der Lingen *et al.,* 2002). Whether an increase in offshore spawning is an effect or a cause of high sardine biomass has recently been questioned by MacCall (2002). That author suggested that the ability of sardine to switch between offshore and nearshore spawning habitats allows this species to position itself so as to benefit from periods of different offshore boundary current flow regimes that affect reproduction-related physics of the offshore and nearshore habitats.

If the eastward shift is a result of a decrease in sardine abundance off the west coast, this may reflect the depletion of the west coast component of the sardine population, or the depletion of the west coast sub-stock if such exists, as the southwest coast and WAB continue to be the area most heavily fished by the fleet. If true, this possibility may have potentially serious consequences, since intra-specific genetic heterogeneity with associated differences in small pelagic fish populations may be a possible mechanism/strategy to minimize the risk of poor environmental conditions adversely impacting on recruitment success (Bakun, 2001).

Alternatively, the eastward shift may reflect a habitat switch in response to altered environmental conditions, either arising from changes in boundary current flow regime or some other aspect of variability such as increased inter-specific competition between sardine and anchovy arising from the very high biomass levels of these two species observed since 2000. Examination of the environment off the South African west and south coasts through the derivation of a satellite-derived enrichment index (that proxies chlorophyll *a* biomass) has shown that phytoplankton biomass off the west coast was lower than average in 2001 (in the St Helena Bay region in particular), but above average over the south coast in that year (Fig. 6). Additionally, anchovy recruitment was exceptionally high in 2000 and 2001, and those recruits would have exerted strong predation pressure on zooplankton stocks in the inshore domain of the west coast, as evidenced by a decline in zooplankton biomass in St Helena Bay during the autumn-winter period in both 2000 and 2001 (Fig. 7). The zooplankton recovered through the summer of 2000/2001, but remained low through the subsequent summer of 2001/2, possibly arising from a combination of substantial predation pressure by anchovy recruits and the low phytoplankton concentrations during the winter of 2001 (Fig. 6).

Adult sardines, which appear to live further offshore on the west coast than do anchovy, would have experienced reasonable microzooplankton and phytoplankton concentrations on which they would have been able to feed throughout the winter in 2000, but much reduced concentrations in the winter of 2001. Moreover, during the subsequent summer of 2001/2, zooplankton remained at low levels. On the Agulhas Bank, the phytoplankton maximum develops in autumn months from March to May

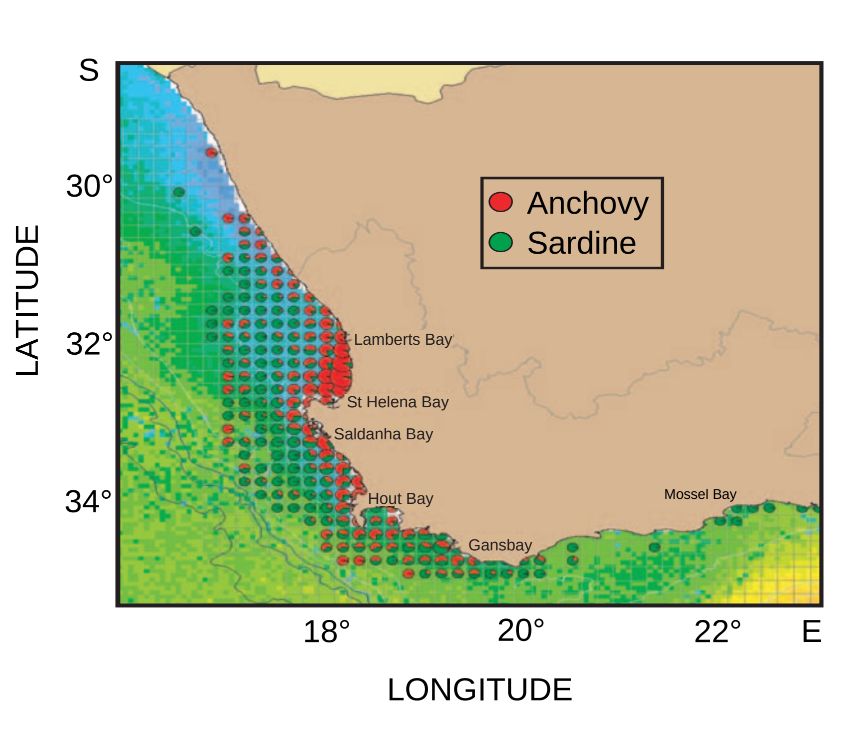

Figure 2. Output from ArcView GIS showing sardine and anchovy catches by area (10' by 10' block) over the period 1987-1998. Circle size is proportional to catch size, and the landing sites (except Port Elizabeth [approximately 26°E]) are indicated.

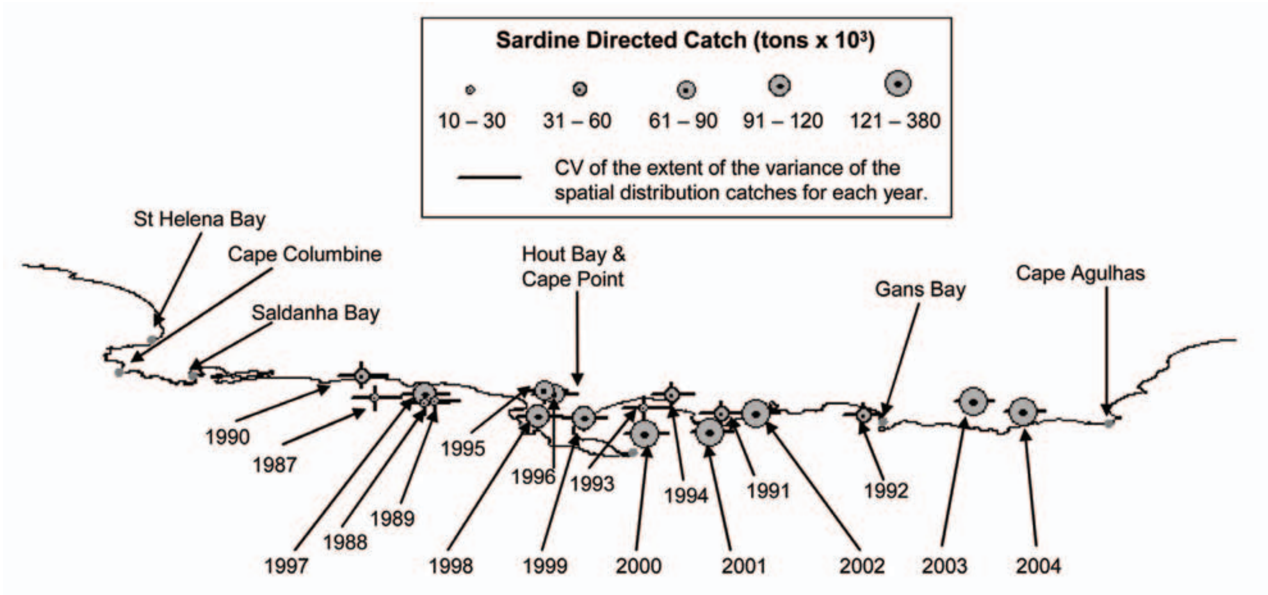

Figure 3. Annual centre of gravity of sardine catches from 1987 to 2004 along a linearized South African coastline. Circle size is proportional to annual catch, and the CV of the alongshore (horizontal) and across-shore (vertical) variability in catch CoG are shown (T. Fairweather, unpublished data).

each year. Although chlorophyll *a* concentrations on the south coast appear much lower than on the west coast, much phytoplankton activity on the Agulhas Bank occurs at subsurface maxima (Probyn *et al.*, 1994). Hence satellite-sensed information only reflects chlorophyll distribution close to the surface, but nevertheless it does detect the major distribution patterns. Higher concentrations at the subsurface maxima are often close to the 1% light level and so are limited in terms of primary productivity. Phytoplankton on the Agulhas Bank is highest in offshore extent and concentration at three locations: the inshore WAB (19°E); the cold ridge area off Mossel Bay (22°E) and in Algoa Bay off Port Elizabeth (26°E). These areas are often coincident with sardine distributions (Fig. 4). A substantial increase in phytoplankton biomass over the CAB and EAB occurred in 2000, and again in 2001 and 2003 (Fig. 6), which would have improved feeding conditions for sardine in this region. Sardine were still on the west coast in 2000, but appeared to vacate that region and move to the south coast sometime in 2001.

Consequences of the eastward shift in sardine distribution include increased costs to the pelagic fishery arising from the increased distance between catch locations and processing plant locations; increased costs are a significant problem in a relatively large volume/low profit fishery such as this and this has led to consideration of developing sardine-processing facilities on the south coast. Additionally, the eastward shift in sardine distribution is also likely to have significant ecological consequences, the severity of which will increase the longer the shift persists. Changed sardine distribution patterns are likely to impact on the distribution patterns of marine predators that feed mainly on sardine. Colonies of African penguin (*Spheniscus demersus*) breeding on islands off South Africa's west coast have declined in relative importance (% of total population) whilst that of south coast colonies has increased (Crawford, 1998). The decline in sardine abundance off the west coast may have a similar impact on west coast seabird populations (such as the colony of Cape gannet, *Morus capensis* in Lambert's Bay) to that which has been documented in the northern Benguela, where the collapse

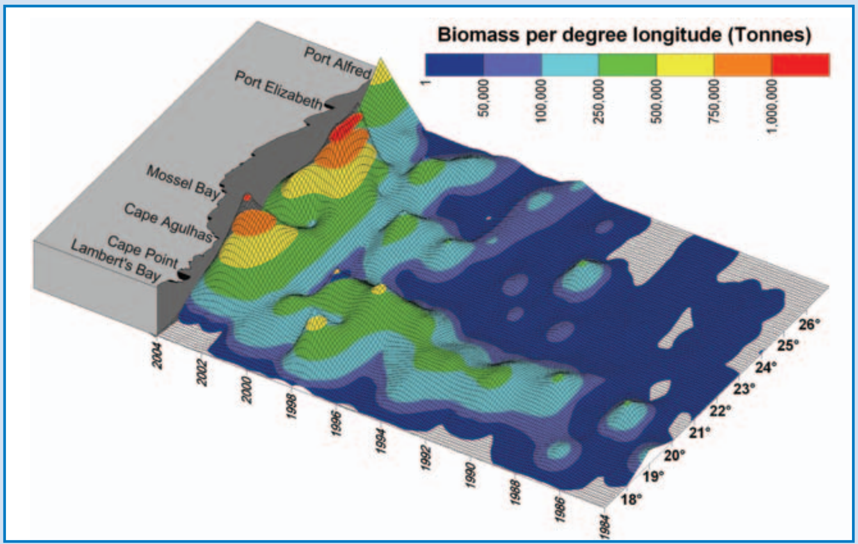

Figure 4. Biomass of sardine by degree longitude along a linearized South African coastline as observed during annual spawner biomass surveys 1984-2004 (J. Coetzee, unpublished data).

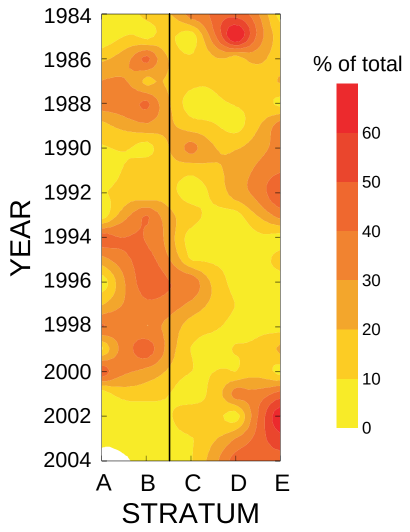

Figure 5. Changes through time in the distribution of sardine eggs in the southern Benguela as seen from data collected during annual surveys. The x-axis represents the coastline, which has been "straightened" and divided into five strata (see Figure 1b: A is the west coast; B is the southwest coast; C is the WAB; D is the CAB; E is the EAB), and the percentage contribution to total egg abundance during the survey is shown for each strata by year, and contouring is used to interpolate between years and strata. The vertical black line indicates the approximate position of Cape Point. Updated from van der Lingen et al. (2001).

of the sardine population and its subsequent contraction to the north in the Angola/Benguela frontal region was followed by a collapse in gannet and penguin populations (van der Lingen *et al.*, submitted).

Management responses to the eastward shift could include a consideration of spatially-explicit catch limitation that would reduce fishing intensity on sardine off the west coast, and/or the identification of areas that could be closed to pelagic fishing either entirely or seasonally in order to ensure an adequate food supply for land-based breeding colonies of predators. Further research should be conducted, including characterization of boundary flow regimes during periods of west and south coast spawning, further characterization of abiotic and biotic parameters off the west and south coasts, and genetic analyses to determine whether the South African sardine population comprises more than one stock.

Acknowledgements

This article is a contribution by South African and French scientists to the collaborative research programme ECO-UP (Structure and Functioning of Exploited Upwelling Ecosystems: Comparative Analyses within the Framework of an Ecosystem Approach to Fisheries). We wish to acknowledge discussions on this topic held with other members of the Sardine Eastward Shift Task Group, namely Dr D. Durholtz, Mr G.G. Louw and Dr A. Badenhorst.

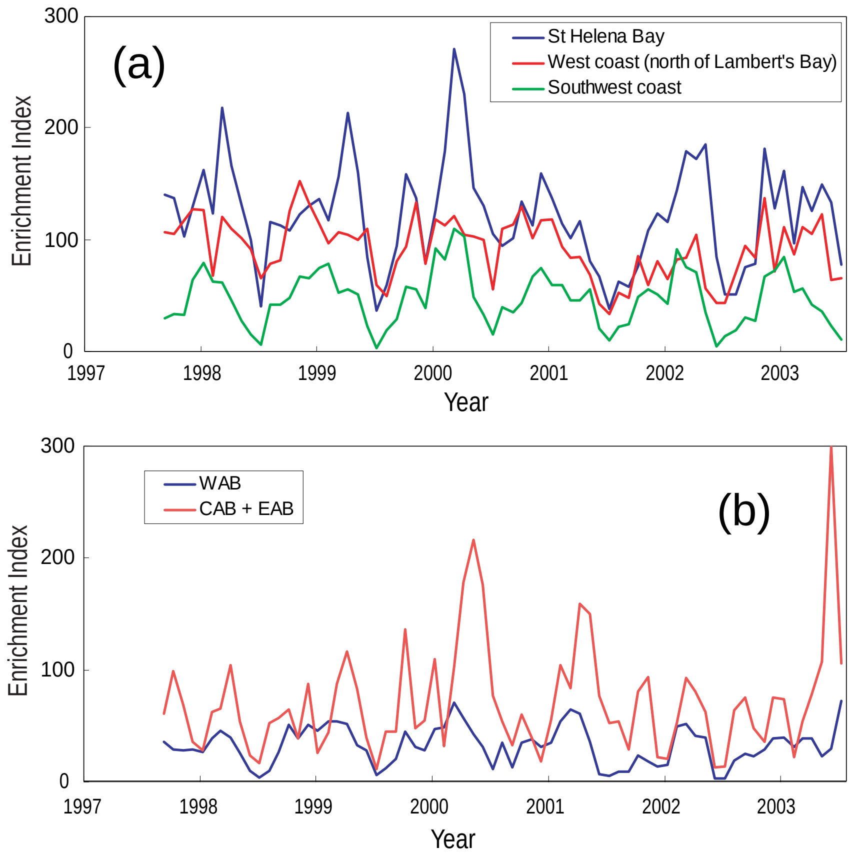

Figure 6. Monthly variability in the satellite-derived enrichment index from September 1997 to July 2003, off (a) South Africa's west (St Helena Bay and the west coast north of Lambert's Bay) and southwest coasts, and (b) the Agulhas Bank (the WAB, and the CAB and EAB combined; H. Demarcq, unpublished data).

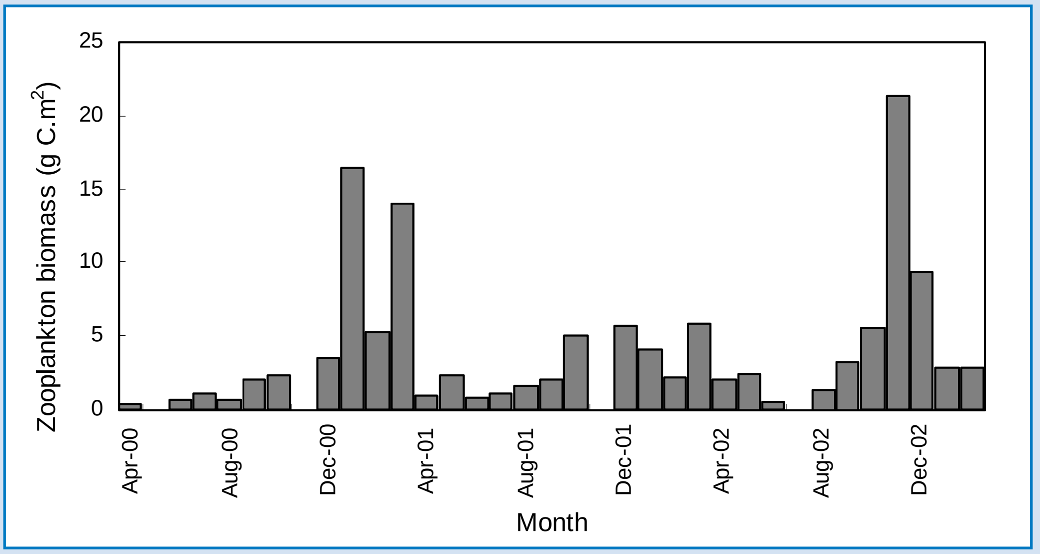

Figure 7. Zooplankton biomass (mg C.m^{-2}) on the inshore stations of a transect in St Helena Bay, April 2000 to February 2003, showing low summer (October-March) values in 2001/2 after a winter of low phytoplankton and high predation pressure from anchovy recruits (L. Hutchings, unpublished data).

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SO GLOBEC and the Scientific Committee on Antarctic Research (SCAR)

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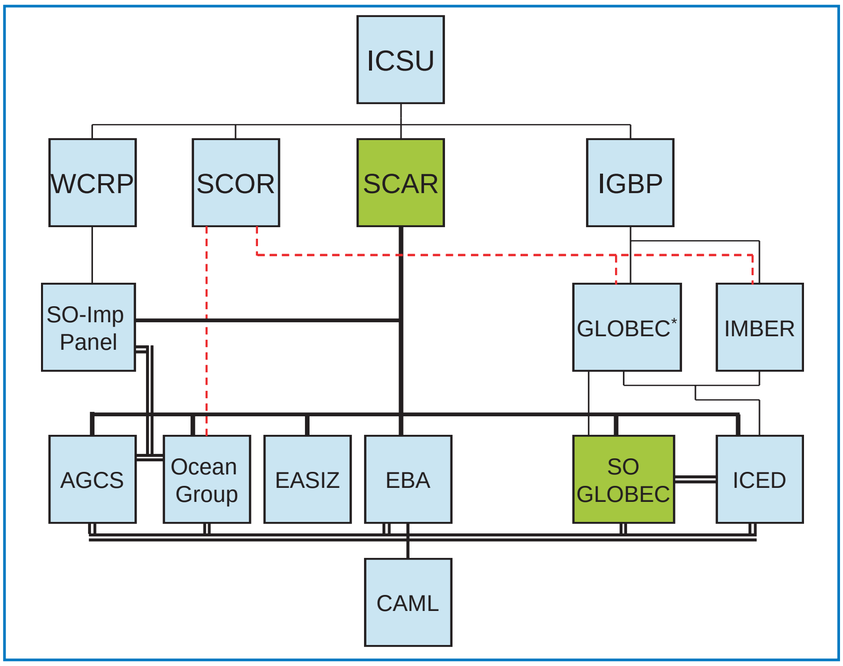

*Figure 1. Relationships within the ICSU family between SCAR's activities and those of other ICSU groups such as IGBP, WCRP, and SCOR. See text for explanation of acronyms. Heavy lines: formal links between SCAR or SCAR-related activities; double lines: informal links between SCAR activities and between them and others; dashed line: links to SCOR. *GLOBEC is also sponsored by the Intergovernmental Oceanographic Commission (IOC).*

The Scientific Committee on Antarctic Research (SCAR) is the leading independent organisation for facilitating and coordinating Antarctic research (http://www.scar.org). It coordinates most of the international scientific activities taking place on a pan-Antarctic scale in Antarctica and the Southern Ocean, constructing and maintaining the international links and partnerships that enable that research to be conducted. Large global international programmes such as the International Geosphere-Biosphere Programme (IGBP) and the World Climate Research Programme (WCRP) work alongside SCAR in progressing scientific understanding of the high southern latitudes and their role in the global system. As reflected in Figure 1, all of these organisations are part of the International Council for Science (ICSU), and are working together as members of the ICSU family with complementary responsibilities.

In October 2004, reflecting the partnership approach to international coordination, and the complementary roles of different members of the ICSU family, SCAR and the Global Ecosystems Dynamics (GLOBEC) programme signed a Letter of Agreement that established SCAR as a co-sponsor of the Southern Ocean GLOBEC (SO GLOBEC) programme (Fig. 1). This co-sponsorship is based on the many common interests that GLOBEC and SCAR share in the Southern Ocean. As a result there is much to be gained for future Southern Ocean research from a synergy between GLOBEC and SCAR. A link between SCAR and SO GLOBEC at this time will ensure that both communities work together to make integrated and comprehensive contributions that address the goals of the International Polar Year (IPY), which runs from 1 March 2007 to 1 March 2009. SCAR will be represented in SO GLOBEC planning and science activities by Dr. Mike Meredith, the Head of the Atmosphere and Ocean Group of the British Antarctic Survey (BAS). Dr. Meredith has been active in Southern Ocean research for 15 years and has a strong interest in interdisciplinary ocean science.

SCAR has a long-standing interest in the biology and ecosystems of the Southern Ocean. The SCAR-led programme on Biological Investigations of Marine Antarctic Systems and Stocks (BIOMASS), which began in 1976 and lasted for about a decade, significantly improved our understanding of the Antarctic marine ecosystem. It also formed the basis for enabling effective management of the living resources of the Southern Ocean, a task now carried out by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). BIOMASS in effect paved the way for the Joint Global Ocean Flux Study (JGOFS) and GLOBEC efforts in the Southern Ocean. Following BIOMASS, SCAR's marine biological efforts in the Southern Ocean were focused through its Working Groups (now Expert Groups) on birds and seals, through its work on the Evolutionary Biology of Atlantic Organisms (EVOLANTA; focused south of the polar front), and through its programme on the Ecology of the Antarctic Sea-Ice Zone (EASIZ). EASIZ is now complete, but EVOLANTA is continuing in another form through the new SCAR Scientific Research Programme on Evolution and Biodiversity in the Antarctic (EBA), which is described more fully at http://www.scar.org/researchgroups/lifescience/. The draft Implementation Plan for EBA was refined at the 9th SCAR International Biology Symposium, which took place in Curitiba, Brazil, in July 2005. A final draft should be published in late 2005. The EBA programme includes continuing work on the biology of the Southern Ocean (which for SCAR purposes is everything south of the northern boundary of the Antarctic Circumpolar Current). A substantial amount of that work will be carried out as part of the Circum-Antarctic Census of Marine Life (CAML; see http://www.caml.aq). Part of SCAR's partnership efforts with SO GLOBEC will be to encourage the involvement of GLOBEC scientists in these new programmes.

The primary objectives of the GLOBEC programme require understanding the role of the oceanic circulation and climate in governing variability in the marine ecosystem. SCAR's interests in the physics of the Southern Ocean and in the role of the Southern Ocean in the climate system, are reflected in its co-sponsorship, with the WCRP's programmes on Climate Variability (CLIVAR) and Climate and Cryosphere (CliC), of the Southern Ocean Implementation Panel (Fig. 1). Linkages between the ocean, ice and atmosphere around Antarctica and in the Southern Ocean are being explored in a new SCAR Scientific Research Programme on Antarctica in the Global Climate System (AGCS; see http://www.scar.org/researchgroups/physicalscience/). SCAR also has an active interest in sponsoring the development of interdisciplinary research in the Southern Ocean, and to that end is a co-sponsor of the newly formed programme on Integrated Analyses of Circumpolar Climate Interactions and Ecosystem Dynamics in the Southern Ocean (ICED), which is being developed as a joint initiative between GLOBEC and the Integrated Marine Biogeochemical and Ecosystem Research (IMBER) programme. IMBER, like GLOBEC, is co-sponsored by the IGBP and ICSU's Scientific Committee on Oceanic Research (SCOR; Fig. 1).

Finally, together with SCOR, SCAR has recently formed an Oceanography Group to encourage an inter-disciplinary approach to Southern Ocean observations, modelling and research, recognising the interdependence of physical, chemical and biological processes in the ocean at present and in the past. Among other things this group will help to ensure that the many national contributions being made by SCAR member countries to ocean science are better coordinated in future and that data sets developed by these national programmes are available to all through some central mechanism. We believe that this will make a significant regional contribution to the success of globally driven initiatives like SO GLOBEC, and ICED. We look forward to working jointly with GLOBEC and ICED scientists to take these various initiatives forward to the mutual benefit of the whole scientific community.

Puerto Madryn Workshop 2004: Analysis of El Niño Southern Oscillation Impact in the Southern Ocean Applying Digital Cartography

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Introduction

The Southern Ocean is an active component of the climate system. It causes cycles of natural climate variability on time scales ranging from years to centuries. It is a major global thermal regulator and it can play an active role in climate change and variability by providing important feedbacks. However, climate change and variability can affect the southern ocean by altering the nature and biomass in the ocean and on surrounding islands, shores and ice.

Although they still remain largely unknown, the impacts of climate change and climate variability are manifested in the physical environment at large scale (i.e. Antarctic sea ice extent) and in biological dynamics (i.e. changes in population of prey and predators).

A common method to study these effects is to build models. A model is a substitute for a real system representing some aspects of it. They are useful when they help us in learning something new about the systems that they represent. We can use the model to perform sensitivity studies. We will test our model, watch the results and try again. Along the way, we will improve our understanding of the natural trajectories of environmental systems assessing how changes in the key system variables alter the system's dynamic behaviour. Such sensitivity studies can help to identify leverage points of a system, and to estimate the risks or benefits associated with proposed or accidental changes in a system.

Objective: Development of a GIS model to study the impact of *El Niño* on the Bellingshausen Sea

Geographic Information Systems (GIS) are computer-based information systems that enable the capture, modelling, manipulation, retrieval, analysis and presentation of geographically referenced data. A GIS is a system specifically designed to work with data referenced by spatial or geographic coordinates. It is therefore both a database system with specific capabilities for spatially referenced data, as well as a platform for analytical operations to work with the data. A model built with GIS tools usually refers to a spatial model. One of the strongest and most successful application

Workshop participants. Left to right, back row: Arnaldo Jaime, Pedro Baron, Peter Pulsifer, Steffen Vogt. Front row: Anna Fabiani, Zulma Stanganelli, Daniel Vergani.

areas of GIS has been in modelling spatial changes in environmental systems. Spatial models are necessary when studying the Southern Ocean ecosystem, as the marine environment is heterogeneous, biomass varies, and marine organisms such as squid, birds and marine mammals continuously move throughout the system.

Target areas and species

The proposed target area is the Antarctic Peninsula including Bellingshausen Sea region where the teleconnection with tropical anomalies has been described. Target species to measure the impact are southern elephant seals (*Mirounga leonina*), adelie penguins (*Pygoscelis adeliae*), squid (*Psycroteutis glacialis*) and Antarctic krill (*Euphausia superba*).

To study the consequences of the Bellingshausen's anomalies on the South Atlantic ecology, this project will develop a model based in Patagonia, with the inclusion of new and historical biological and environmental information obtained there. Target species in Patagonia include southern elephant seals (*Mirounga leonina*), penguin (*Spheniscus magellanicus*) and squid (*Loligo gahi*).

Results of the Meeting

Presentation and discussion where divided in two main components: 1) the digital cartographic support that includes the data base structure and the tools that will be employed in the analysis and 2) the thematic data set, which comprises the ecological data from predator and prey and the environmental data.

1) Digital Cartographic Support

Two main projects were presented at the workshop: the King George Island GIS (K-GIS) from the University of Freiburg (Germany) and the Canadian based SCAR Cybercartographic Atlas of Antarctica Project (CAAP) from the Carleton University (Canada).

The CAAP includes the integration of elephant seal parameters measured at King George Island, climatic and fishery information in the Bellingshausen Region as a pilot study to examine the strength and the weakness of the object-oriented approach to geographic data modelling.

This research pursues the following goals:

- To discuss the principles, strategies and mechanisms of the object-oriented approach to geographic data modelling.
- To design a custom data model on the southern elephant seals at the Antarctic Peninsula region using the object-oriented approach within the GIS environment. The object-oriented approach extends the power of marine spatial analyses by incorporating behavioural aspects into the data. This data model can be used as a common template for assembling and publishing the existing data and additional data that will be collected in the future by marine scientists.
- To provide a friendly cartographic interface for users. Although cartographic visualization of data continues to be more and more flexible in terms of, for example, 'on-the-fly' data reprojection and classification, historically these systems have not been readily accessible to non-expert users. The geographic data modelling approach explored has the potential to more readily transfer geographic data and analysis of results to users. The resulting cartographic interface allows users to manipulate, retrieve, analyse and present geographically referenced data.
- To promote networking and data sharing through established standards and the Internet within Antarctic scientific community. Antarctic scientific work is carried out across a wide range of disciplines and is executed through a large number of organisations. To maximize data utilization and at the same time minimize efforts, sharing data sources is needed. The Internet, almost a part of everyday life, is an extremely efficient tool for data sharing.

2) Thematic Component

Ecological studies in elephant seals, penguins and squid that constitute the thematic axis of the model were presented by researchers from ESRG (Italy), IFM-GEOMAR (Germany), and CENPAT (Argentina). Integration with the other projects participating in the meeting were discussed, as well as the application of this methodology in Patagonia and the basis for the future cooperation was stated. Special importance is given to predator-squid interaction, keeping in mind the overall role of squid in the marine environment, their significance as a food resource for higher trophic levels and their increasing importance as an economic resource.

In comparison with other marine groups, such as crustaceans, fish or marine mammals, ecological studies on cephalopods are strikingly sparse. Two major shortcomings are responsible for this: (1) cephalopods are difficult to catch and mostly taken as by-catch in surveys targeting other taxa, (2) they have complicated life cycles and distribution patterns which are only roughly understood for a few species. Consequently, it is of great importance to intensify studies on trophic interrelationships where cephalopods are involved, because they will help to elucidate cephalopod ecology and form the basis for further ecosystem modelling.

Organisation and Sponsors

The organisation of the workshop held in the Centro Nacional Patagonico in November 2004 was carried out by Daniel Vergani, Proyecto Atlas Centro Nacional Patagónico (CENPAT-CONICET). Funding for the workshop has been approved by the Ministero degli Affari Esteri (Italy) and the Agencia Nacional de Promoción Científica y Técnica (ANPCYT).

European Network of Excellence for Ocean Ecosystems Analysis (EUR-OCEANS): Assessing the impact of climate change on marine ecosystems, including living resources

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The world's oceans are currently undergoing major trials, both from global warming and from the over-exploitation of marine resources, which deeply perturbs ocean ecosystems. In order to define a basis for sustainable development at a global level, it is time for us to develop tools to better forecast the evolution of the ocean's ecosystems. This is the main objective of the European Network of Excellence, EUR-OCEANS, which started in January 2005 with the financial support of the European Commission. In order to achieve this objective, a major modelling effort must be made, allowing the convergence of three scientific communities who have traditionally worked in isolation: physical oceanographers and chemists, marine biologists, and fisheries experts interested in the ecosystem approach to fisheries management. EUR-OCEANS will take into account the reactions of marine systems both at the regional and the global scale, by considering systems of relevance with respect to their sensitivity to climate change and/or their importance for fisheries: the North Atlantic Ocean and its adjacent seas (Mediterranean and Baltic Seas), the polar oceans (Arctic and Antarctic), and coastal upwelling systems (from Portugal to South Africa).

EUR-OCEANS gathers 160 scientists, from 66 marine research institutes and universities in 25 countries. The network will receive financial support of 10 million euros from the European Commission for 4 years. Additional funding contributed by the participating institutes is estimated at 30 million euros. One of EUR-OCEANS original features is to create and collaborate with a network of 13 aquariums in Europe, which will take on the dissemination of results to a broader audience (around 13 million visitors annually).

EUR-OCEANS Joint Programme of Activities consists of ten Work Packages (WP):

Integrating activities:

WP 1 Networking:

WP 1.1 Sharing facilities
(lead by Karin Lochte, IfM-GEOMAR, Germany)

WP 1.2 Mobility and communication
(lead by Carlos M. Duarte, CSIC/IMEDEA, Spain)

WP 2 Data integration:

WP 2.1 Observing systems
(lead by Richard Lampitt, NOC, United Kingdom)

WP 2.2 Networked databases
(lead by Michael Diepenbroek, University of Bremen, Germany)

WP 3 Model integration:

WP 3.1 Model interfacing
(lead by Patrick Monfray, CNRS, France)

WP 3.2 Global Ocean
(lead by Corinne Le Quere, British Antarctic Survey, United Kingdom)

WP 3.3 Earth System
(lead by Fortunat Joos, University of Bern, Switzerland)

Jointly Executed Research

WP 4 Ecosystems end-to-end
(lead by Mike St John, University of Hamburg, Germany)

WP 5 Biogeochemistry
(lead by Frede Thingstad, University of Bergen, Norway)

WP 6 Ecosystem approach to marine resources
(lead by Philippe Cury, IRD, France)

WP 7 Within-system integration
(lead by Patrick Monfray, CNRS, France)

Spreading of Excellence

WP 8 Training for researchers and other key staff
(lead by Carlos M. Duarte, CSIC/IMEDEA, Spain)

WP 9 Transfer to socio-economic users
(lead by Manuel Barange, GLOBEC IPO, PML, United Kingdom)

WP 10 Public outreach
(lead by Sylvain Ghiron, Oceanopolis, France)

It is scheduled that EUR-OCEANS will lead to the creation of a European multi-site Research Institute in 2009.

Held in Paris on 14-15 April 2005 and introduced by the French Ministry for Research, EUR-OCEANS kick-off meeting was a great opportunity for over 150 scientists involved in the network to get familiar with the planned activities and to start to organise their work.

At the international level, EUR-OCEANS is directly relevant to the International Geosphere-Biosphere Programme (IGBP) and its core projects GLOBEC (Global Ocean Ecosystem Dynamics) and IMBER (Integrated Marine Biogeochemistry and Ecosystem Research), aiming to contribute considerably to their European component. It is worth mentioning that the International Project Office of IMBER will be based at the European Institute of Marine Studies, IUEM (University of Western Brittany, National Centre for Scientific Research) in Brest, while the GLOBEC International Project Office leads the EUR-OCEANS Work Package on transfer of knowledge to socio-economic users. EUR-OCEANS has also developed strong relationships with the USA. Among its first initiatives, the BASIN workshop (Basin-scale Analysis, Synthesis, and INtegration) was held in March 2005 in Reykjavik, Iceland, upon an initiative of the NSF (National Science Foundation), EUR-OCEANS and GLOBEC. This workshop has laid the foundations for a research initiative to understand the dynamics of the North Atlantic ecosystem at the basin scale.

See the EUR-OCEANS website (http://www.eur-oceans.org) for further details.

A new programme with focus on sustainable ecosystems and biogeochemistry in the coastal ocean of China

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The China GLOBEC programme has reached its third phase after nearly 10 years of endeavour of China GLOBEC I (BoSEC, 1997-2000) and China GLOBEC II (EYSEC, 1999-2004) on ecosystem dynamics and sustainable utilization of marine living resources in the coastal ocean of China. A new 5 year programme on GLOBEC and IMBER has been approved by the Ministry of Science and Technology of China (MOST) with a total funding of US$4.0 million from 2006 to 2010. Prof. Qisheng Tang is once again nominated as the Chief Scientist and nearly 70 scientists will be involved in the programme. The program is entitled 'Key Processes and Sustainable Mechanisms of Ecosystem Food Production in the Coastal Ocean of China' and will carry out integrated studies on multidisciplinary subjects by focusing on core subjects such as coupling mechanisms of the marine biogeochemical cycles and the end-to-end food web in the China seas. It aims at gaining a better understanding of supporting, regulating and producing functions of food production, and the sustainable mechanisms in the coastal ocean ecosystems of China seas from the perspectives of both anthropogenic impacts and natural changes.

Chinese GLOBEC scientists have paid a lot of attention to ocean study in IGBP II, in particular to ocean synthesis research when IGBP began to evolve into an exciting second phase in 2003. To respond to the development of ocean research by two closely integrated collaborative projects GLOBEC and IMBER in IGBP II, Prof. Qisheng Tang suggested the integration of Chinese GLOBEC and IMBER studies after the International Open Science Conference on OCEANS. It is recognized that a new committee of GLOBEC-IMBER replacing the CNC-IGBP/GLOBEC committee would provide a better structure to guide an integral Chinese ocean research programme in the coming years. The CNC-IGBP/GLOBEC-IMBER committee aims to encourage the development of a GLOBEC and IMBER project leading toward integrated ocean and synthesis studies. The committee takes responsibility for building the research framework on the hot spots of Chinese ocean studies of GLOBEC and IMBER. It places emphasis on developing synthesis studies such as biogeochemical cycles and marine food webs.

One of the important activities of the CNC-IGBP/GLOBEC-IMBER Committee is to organise a Xiangshan Sciences Conference which is the topmost and most influential scientific regular forum in China by bringing together distinguished scientists at a national level. The GLOBEC-IMBER Xiangshan Sciences Conference in the spring of 2004 was entitled 'Sustainable Ecosystem and Biogeochemistry in the Coastal

The chairpersons of GLOBEC and IMBER SSC and Chinese scientists Conference in Beijing, 26-28 May 2004

Ocean' to strengthen the understanding and development of GLOBEC and IMBER in China. Four scientific topics proposed by the CNC-IGBP/GLOBEC-IMBER Committee were discussed at the conference. The topics included the impact of physical processes on biogeochemistry, carbon cycle and influence of recent anthropogenic activity, biogeochemistry processes of marine nutrient elements and its control, and marine food webs, ecosystem diversity, stability and productivity.

The China GLOBEC programme has achieved many successes during the past 10 years including:

1. Construction of the basic framework of the China GLOBEC system upon 6 key scientific questions
2. Energy flow between key species and sustainable management model of food web
3. Zooplankton population recruitment and microbial loop contribution
4. Ecological functions of key physical processes
5. Nutrient circulation and bottom-pelagic system coupling

The new China GLOBEC-IMBER program from 2006 to 2100 will give priority to the marine biogeochemical cycles and key processes of end-to-end food webs in the China seas. The four major scientific questions to be addressed are the biogeochemical processes of food production, physical mechanisms of biogenic element cycle and supplement, coupling mechanism of primary production with major biogeochemical processes and food web trophodynamics of major biological functional groups. The research activities will mainly focus on some unique sub-ecosystems in the Yellow Sea and the East China Sea with studies on ecological capacity. The new China program on GLOBEC and IMBER will address:

- Supporting role of main biogeochemical processes in food production
- Key physical processes of biogenic element cycle and supplement
- Primary production coupling with main biogeo-chemical processes
- Food production processes of biological function groups together with their sustainable models

The implementation of the program is expected to make breakthroughs in some of the frontier scientific fields like the key processes of food production in the coastal and shelf ecosystems and sustainable utilization mechanisms of marine living resources. The program detailed in the implementation plan has been divided into the following 8 projects:

1. Transfer and cycle of biogeochemical elements in food web
2. Key process of biogenic substance exchanges on the main interfaces of coastal waters
3. Physical mechanisms of biogenic element supply in the typical shelf sea ecosystems
4. Role of the microbial loop in food production processes in coastal waters
5. Trophodynamics of phytoplankton community growth and primary production processes
6. Role of zooplankton function groups in food production processes
7. Functional diversity and food production processes at high trophic levels
8. Anthropogenic impact on food production processes and sustainable yield models in the coastal ocean

The goal of the programme is to improve knowledge and provide scientific basis for ensuring food supply in the new century, by establishing a marine management system based on both sustainable food production an ecosystem.

"Oceans and climate change - what for the future?" a summer course in San Sebastián, Spain

Ángel Borja, AZTI-Tecnalia, Spain (aborja@pas.azti.es)

In recent years, climate change and its effect upon humankind has been debated in the scientific community and society. In the Basque Country this debate has centered on climatic aspects and the effects on atmospheric topics (changes in temperature and rainfall, etc.) and on human aspects (increase in floods and droughts, influence upon food production, migrations, etc.). However, little debate has taken place on climatic changes affecting the sea, both at global and local scales and the way in which this can impact upon marine ecosystems, marine resources and use of the sea.

Hence, from 4 to 6 July 2005, a summer course took place in San Sebastián organised by Ángel Borja (AZTI-Tecnalia), within the XXIV Summer Courses of the University of the Basque Country. Over 100 students from different geographical areas and skill backgrounds attended the course.

The objectives of the course were: (i) to synthesize the recent scientific research on climate change and oceans; and (ii) to focus upon a regional and global perspective, through lectures presented by international experts, in respective areas of specialisation. Hence, the course has been structured around integrating regional (Atlantic, Mediterranean) and global research (oceans at worldwide and North Hemisphere scale).

On the first day Ángel Borja introduced the problems associated with climate change and the international research undertaken in recent years. Professor Manuel de Castro (University of Castilla-La Mancha, Spain) talked about the modelling of climate change, and the relationships between atmosphere and oceans. Professor Paul Pearson (University of Cardiff, UK) provided students with some lessons from the past, explaining climate change on a geological scale.

Professors participating in the Summer Course, in San Sebastian. Upper left: Angel Borja and Carlos Duarte; upper right: Paul Pearson; lower left: Grégory Beaugrand; and lower right: Manuel de Castro.

The second day continued with Professor Pearson linking climate change and the evolution of some species, such as foraminifers. Subsequently, Professor Grégory Beaugrand (CNRS, France) talked about the relationships between climate change and the impact on marine plankton, including changes in phenology.

Professor Carlos Duarte (IMEDEA, Palma de Mallorca, Spain), presented two talks on global change: the climate change impact on economy, fishing and marine resources; and changes in the Mediterranean in recent years. The course ended with a presentation by Professor Angel Borja, on changes in the Atlantic, especially of benthos and fishes.

Taking into account a recent report by the Spanish Office of Climate Change (Moreno Rodríguez, 2005), several discussions took place on the potential effects of climate change on the Atlantic and Mediterranean Seas, especially near the Iberian Peninsula.

Following this report, predictions for next 50 years include: (i) an increase in mean air temperatures (especially in summer and the inner part of the Peninsula); (ii) a decrease in annual precipitation; and (iii) an increase in sea level. Hence, following this scenario the following predictions can be made: (i) a reduction in Spanish marine productivity; (ii) changes in the abundance of organisms (including all levels of the trophic nets); (iii) changes in recruitment (in some cases, linked to changes in the NAO pattern); (iv) changes in distributional patterns of the species; (v) alterations in some vulnerable systems (such as Posidonia, in the Mediterranean); and (vi) loss of beaches, by increasing erosive processes.

References

Moreno Rodríguez J.M. (Coordinator). 2005. Main conclusions on Preliminary Impact Assessment of the Climate Change effects in Spain (ECCE project), Spanish Ministry of Environment (http://www.mma.es/oecc).

PICES/GLOBEC Symposium on

Climate variability and ecosystem impacts on the North Pacific: A basin-scale synthesis

General Information

Atmospheric forcing, ocean structure, and ecosystem structure and population dynamics vary on many spatial and temporal scales. Dominant temporal scales are diel, seasonal, interannual and longer. In the past ten to fifteen years, marine scientists have begun to document evidence that basin-wide or large-scale changes might be significant forcing for decadal to millennium-scale changes in marine ecosystems. In 1994, the PICES Climate Change and Carrying Capacity (CCCC) Program, a regional program of the IGBP/SCOR/IOC GLOBEC International, was developed to provide a framework for examining climate-ecosystem linkages, mostly on regional scales, but with plans for broader-scale, basin-wide synthesis, in the North Pacific.

The primary scientific objective of this symposium is to present a synthesis of the effects of seasonal to multi-decadal variability on the structure and function of the North Pacific that goes beyond the analysis and understanding developed from studies of a single trophic level, process or region - a true synthesis.

The Symposium is organised by PICES and co-sponsored by GLOBEC.

Dates and Venue

The symposium will be held 19-21 April 2006, at the Hawaii Imin International Conference Center (East-West Center) in Honolulu, USA.

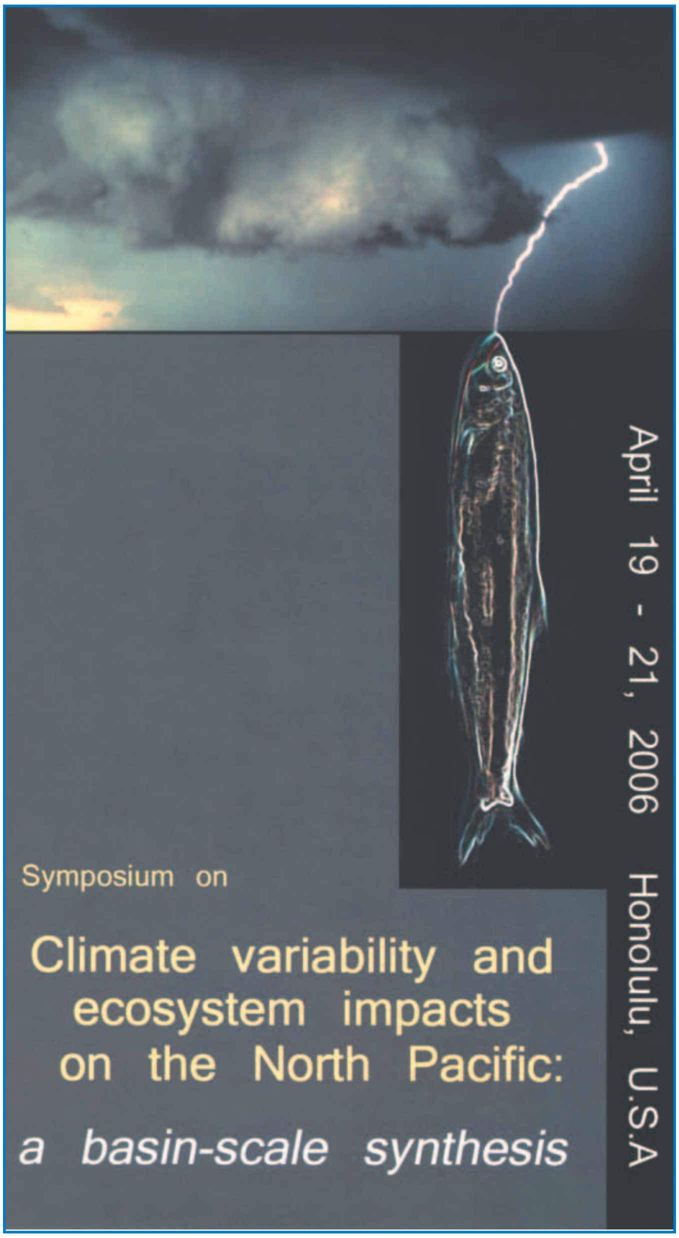
Symposium Structure

The symposium will have a combination of plenary oral sessions and poster sessions each day. Keynote speakers will provide 40 minute overviews and challenges for each science theme. Contributed papers that are accepted will be 25 minutes in length. The number of posters displayed each day will be limited to 30 posters, and poster-only time will be provided for discussion with authors.

Scientific Program

Papers that provide interdisciplinary or multi-regional comparisons on the specific science themes are invited:

Theme 1: Regime shifts, especially, examination of the ocean and ecosystem responses to known strong, infrequent changes in the North Pacific, such as those that occurred in 1977, 1989, and 1998;



Theme 2: Ecosystem productivity and structural responses to physical forcing, with an emphasis on shorter than inter-decadal time-scales-interannual (El Niño-La Niña), seasonal and event scales; and

Theme 3: Pan-Pacific comparisons, with an emphasis on comparisons of similar species or processes from multiple coastal ecosystems and of open ocean-coastal linkages and climate connections.

Papers on related topics will also be considered.

Registration and abstracts

Those wishing to attend are invited to register and submit abstracts through the PICES website (ww.pices.int). The deadline for early registration and abstract submission is 4 November 2005.

A discounted early registration fee of CDN$ 225 (CDN $ 150 for students) will be charged to help cover costs of the symposium. Regular registration (after 4 November) is CDN$ 325 (CDN$ 225 for students) and subject to availability of space. A spousal registration fee is CDN$ 50. Registration is not considered complete until the registration fee is received. Please refer to the PICES Home Page for detailed instructions and forms.

Limited support is expected to be available to assist young scientists (35 years of age or younger) and scientists from countries with "economies in transition" to attend the symposium. Application procedure and forms can be found on the PICES Home Page (www.pices.int/secure/ login.aspx). The deadline for application is 4 November 2005.

Publication

The symposium proceedings will be published in a special issue of Progress in Oceanography. Papers, including those based on poster presentations, will be considered for publication following peer review. Interested authors will be required to submit one paper copy and an electronic version of their manuscript at the time of the meeting. Copies of the proceedings will be sent to all registered participants.

Co-Convenors

Harold P. Batchelder (Oregon State University, USA)

Suam Kim (Pukyong National University, Korea)

Further Information

Complete information and the latest news about the symposium can be found on the PICES Home Page at www.pices.int/meetings/international_symposia/Honolulu2006/default.aspx.

Global Environmental Change: Regional Challenges An Earth System Science Partnership Global Environmental Change Open Science Conference

9-12 November 2006, Beijing, China

Co-chairs: Qin Dahe, Gordon McBean

The first Global Change Open Science Conference, held in Amsterdam in 2001, was a milestone in the scientific, political and public understanding of this far-reaching topic. One outcome of that Conference was the formation of the **Earth System Science Partnership (ESSP)**, a collaboration between:

DIVERSITAS: an international programme of biodiversity science.

IGBP: the International Geosphere-Biosphere Programme

IHDP: the International Human Dimensions Programme on Global Environmental Change

WCRP: the World Climate Research Programme

Since then the ESSP has created four major interdisciplinary Joint Projects on carbon, food, health and water in the Earth System, and has initiated the first of a series of Integrated Regional Studies.

Conference objectives

This Conference provides the opportunity for the presentation of advances since the Amsterdam Conference in our understanding of the natural and social systems of global environmental change and to highlight the ESSP approach to study of the Earth System.

The Conference will highlight advances in our understanding of the physical, biogeochemical, biodiversity and human dimensions aspects of global environmental change.

Science in support of sustainability will be featured, with special sessions on global environmental change research relating to food, water, carbon and human health, as reflected in the ESSP Joint Projects.

Special attention will be given to dynamics, impacts and consequences of the interactions between natural and social systems at regional scales, including extreme events, and how they connect with global scale phenomena.

Research concerning global environmental change in monsoon Asia will also be a particular focus.

Scientists, policy makers, practitioners, scholars, members of the private sector and journalists are invited to participate in this Conference and to submit proposals for sessions and abstracts. Prior to the main Conference, the 2nd International Young Scientists' Global Change Conference (7-8 November 2006) will provide an opportunity for selected young scientists to present and discuss their work.

Important dates

Call for sessions: October/November 2005

Registration opens: October 2005

Call for papers: February – May 2006

For further details, or to submit a session proposal online, see the conference website:

www.essp.org/essp/ESSP2006/

or contact the Conference Secretariat, catherine.michaut@ipsl.jussieu.fr

CALENDAR

30 September-8 October 2005: PICES XIV meeting, including GLOBEC/PICES CCC session, Vladivostok, Russia

10-15 October 2005: CLIOTOP WG1 meeting, Málaga, Spain

17-20 October 2005: GLOBEC Focus 2 WG meeting, Dartington, UK

24-27 October 2005: HMAP Conference OCEANS PAST - multidisciplinary perspectives on the history of marine animal populations, Kolding, Denmark

25-27 October 2005: GLOBEC/IMBER Executive Committee meetings, Brest, France

28-29 October 2005: GLOBEC-IOC Study Group on Regime Shifts, Brest, France

1-3 November 2005: GLOBEC/SPACC Workshop on Image Analysis to Count and Identify Zooplankton, San Sebastian, Spain

3-4 November 2005: EUR-OCEANS NSC meeting, Gatwick, UK

7-10 November 2005: SCOR Working Group 125 on Global Comparisons of Zooplankton Time Series, Silver Spring, Maryland, USA

10-12 November 2005: ICARP II. Research Planning to Understand the Arctic System in a Changing World, Copenhagen, Denmark

9-12 November 2005: 1st DIVERSITAS International Conference on Biodiversity. Integrating biodiversity science for human well-being, Oaxaca, Mexico

20-24 February 2006: AGU Ocean Science Meeting with special sessions zooplankton population variability (OS042) and CLIOTOP (OS060), Honoulu, Hawaii

26 March – 2 April 2006: DISCCRS II Symposium. DISsertations initiative for the advancement of Climate-Change Research, Pacific Grove, California, USA

3-7 April 2006: BENEFIT Forum, Swakopmund, Namibia

April 2006: SCOR WG125 on Global Comparisons of Zooplankton Time Series, Honolulu, Hawaii

3-5 April 2006: Advancements in modeling physical-biological interactions in fish early-life history: recommended practices and future directions, Nantes, France

19-21 April 2006: PICES/GLOBEC Symposium on Climate Variability and Ecosystem Impacts on the North Pacific: a Basin-Scale Synthesis, Honolulu, USA

23-25 April 2006: GLOBEC SSC meeting, Honolulu, USA

DEADLINE FOR GLOBEC NEWSLETTER 12.1: 1 March 2006

GLOBEC INTERNATIONAL

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