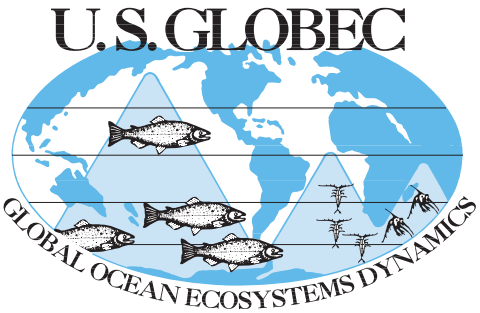
U.S. GLOBEC: A Component of the U.S. Global Change Research Program



U.S. GLOBEC NEWS

Number 13 February 1999

Northeast Pacific Program Moves Forward

by Hal Batchelder

The Global Ocean Ecosystems Dynamics (U. S. GLOBEC) program within NSF/OCE and NOAA's COP has identified coordinated ecosystem studies in the California Current System (CCS) and Coastal Gulf of Alaska (CGOA) as priorities for the next decade. U.S. GLOBEC proposes to investigate large-scale coupling of the CCS and CGOA, and the biophysical mechanisms, through which zooplankton and salmon populations respond to physical forcing and biological interactions in the coastal regions of the two gyres. We are currently soliciting proposals for (1) process-oriented field studies in the CCS; (2) mesoscale surveys in the CCS; (3) long-term observation projects in the CCS; (4) modeling studies in the CCS and the CGOA; and (5) retrospective studies in the CCS and the CGOA. To provide for long-term coordinated strategic planning of the NEP program in the CCS, proposals are being solicited now for all future U.S. GLOBEC research activities in the CCS. This includes process-study research in the two field phases of the CCS program. At this time, the major field process years are anticipated to occur in 2000 and 2002, contingent on the availability of funding. In the event that sufficient funding is not available to support a full field program in 2000, the field years will be delayed a year, occurring in 2001 and 2003, respectively.

U.S. GLOBEC's NEP program emphasizes studies on the biology/ecology of juvenile salmon, the euphausiids *Euphausia pacifica* and *Thysanoessa spinifera*, several large copepods, and forage fishes (salmon prey) in coastal regions; and how these populations are controlled by climatically-variable physical forcing, especially at large-to meso-scales.

Several other national and international programs will examine similar ecosystems and processes, and proposers should be aware of these ongoing and planned efforts in the NEP. Examples of these are Canada GLOBEC, NOAA's Pacific Northwest Coastal Ecosystems Regional Study (PNCERS), the California Cooperative Oceanic Fisheries Investigations (CalCOFI), the North Pacific Marine Science Organization (PICES) Climate Change and Carrying Capacity (CCCC) Program, the Coastal Ocean Processes (COOP) program and others (many of these have websites, links to which can be found on the U.S. GLOBEC NEP homepage at: http://www.usglobec.berkeley.edu/nep/index.html).

These national and international investigations complement the research planned by U.S. GLOBEC in the Northeast Pacific Ocean. They provide a unique opportunity for both regional and inter-regional comparisons and the evaluation of large-scale climatic influences (e.g., the El Nino - Southern Oscillation) on several pan-North Pacific species (e.g., salmon and *Euphausia pacifica*).

The U.S. GLOBEC Northeast Pacific Implementation Plan (U.S. GLOBEC Report No. 17) was developed following several community-wide meetings at which U.S. scientists from the oceanographic and fisheries communities identified key scientific issues and research prospectuses for the Northeast Pacific region. The overall objectives of the U.S. GLOBEC program are described in the U.S. GLOBEC Initial Science Plan (Report No. 1). Background information pertinent to the Northeast Pacific is found in U.S. GLOBEC Report Nos. 7, 11, 15 and 16. Investigators who plan to

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submit proposals should refer primarily to the NOAA RFP and, secondarily, to the Northeast Pacific Implementation Plan (U.S. GLOBEC Report No. 17).

Copies of U.S. GLOBEC reports are available from the following address or homepage:

U.S. GLOBEC Coordinating Office
University of Maryland Center for Environmental Science
Chesapeake Biological Laboratory
P.O. BOX 38
Solomons, MD 20688
Phone: 410-326-7289
Fax: 410-326-7318
Internet: lagle@cbl.umces.edu
http://cbl.umces.edu/fogarty/usglobec/

Specific information about the NE Pacific Study, including descriptions and points of contact of presently funded GLOBEC NEP projects, can be obtained from the following address or homepage:

U.S. GLOBEC Northeast Pacific Coordinating Office
Department of Integrative Biology
University of California
Berkeley, CA 94720-3140
Phone: 510-642-7452
Fax: 510-643-1142
Internet address:
halbatch@socrates.berkeley.edu
http://www.usglobec.berkeley.edu/nep/index.html

Initial phases of this inter-agency research program in the NEP have supported integrated, multi-investigator, inter-disciplinary programs of modeling, retrospective analysis, and pilot-scale monitoring (henceforth referred to as the Long-Term Observation Program or LTOP). Proposers are advised to refer to the preliminary results from these programs (see http://www.usglobec.berkeley.edu/nep/index.html) prior to preparation of new proposals. Ultimately, the U.S. GLOBEC effort in the Northeast Pacific has an overall goal of improving predictability and management of living marine resources of the region through improved understanding of ecosystem interactions and the coupling between the physical environment and the living resources.

Structure of the CCS Research Program

The NE Pacific Study will comprise five major components: (a) long-term observation programs (LTOP), (b) mesoscale surveys, (c) process-oriented field studies, (d) modeling investigations, and (e) retrospective/comparative analysis. The large range of spatial and temporal scales of important forcing processes and responses in the NEP requires a nested sampling approach (and some associated tradeoffs), which is reflected in the descriptions of the LTOP, mesoscale surveys, and process-studies in the NOAA notice. Here we briefly note some specifics related to the process studies and mesoscale surveys—two new activities of the NEP program.

U.S. GLOBEC process-oriented field research will focus on target species chosen to represent key elements of the marine ecosystem in the northern part of the CCS. These are the euphausiids *Euphausia pacifica* and *Thysanoessa spinifera*, calanoid copepods, and juvenile coho and chinook salmon. Process studies in 2000 will focus on the effects of upwelling and cross-shelf exchange on the population dynamics of the target organisms north and south of Cape Blanco, OR. Where feasible (where timing and geography overlap), parts of the field program may be carried out in close coordination with nearshore interdisciplinary studies of the effects of wind-driven transport conducted by the NSF-funded Coastal Ocean Processes (COOP) program, slated to take place in 2000-2001. Process-oriented studies in 2002 will focus on the effects of upwelling and 3-dimensional mesoscale circulation on the population dynamics of the target species north and south of Cape Blanco. Biotic processes and interactions, including factors affecting primary production and predation processes will be studied in both 2000 and 2002. In the event that funding levels cannot support simultaneous studies north and south of Cape Blanco, it may be necessary to conduct studies north of the cape in 2000 and to the south in 2002. Proposals should consider contingency plans to accommodate such a change.

The primary focus of process studies will be on (a) physical (e.g., stratification intensity; timing of the spring transition; intensity of upwelling) and biological (e.g., prey and predator abundance and distributions) factors influencing the population dynamics and vital rates of juvenile salmon and other target taxa (euphausiids, copepods) in the coastal region; (b) retention and loss of populations of target species, as impacted by mesoscale circulation and cross-shelf transport into the coastal jet off Oregon/No. Calif. (loss) or maintenance in the coastal upwelling zone (retention); and (c) a comparison of these processes (a,b) north and south of Cape Blanco, Oregon.

Mesoscale (ship) surveys are needed to determine the distribution and abundance of the target species in relation to their physical environment during the period of euphausiid recruitment and juvenile salmon entry into the ocean (March to September). This period encompasses the spring-transition in the CCS, the initiation of upwelling and its ramifications for production, as well as the period of ocean entry by juvenile salmon and their first summer of growth. Mesoscale surveys will provide 1) the basis for comparisons of population processes and physical structure and variability, 2) 3-dimensional data for evaluating how LTOP data generalize to a broader region, 3) regional context for in situ process studies, and 4) data needed for

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NEP Posts—(Cont. from page 2)

evaluating coupled circulation-ecosystem models.

Spatially, the ship-based mesoscale sampling should encompass both the nearshore upwelling region and the coastal jet that ultimately carries a large portion of the flow of the California Current. High priority will be given to proposals that would survey a region extending from approximately Newport, OR to Eureka, CA, i.e., about 500 km along shore, and extending from nearshore to 100 km (perhaps more south of Cape Blanco, where the jet meanders further from shore). Sampling of juvenile salmon (trawling) is a critical addition to the CCS component of the NEP program since salmon are a target species of the program. Proposals are solicited that will provide spatial descriptions of juvenile coho and chinook salmon, and their forage prey in the region extending from Newport, OR to Eureka, CA, at the time of ocean entry (approx. April-May) and at the end of the first summer in the ocean (approx. September). These collections would also be useful for examining (a) trophic relationships in the nearshore ecosystem, and (b) genetic structure/stock identity of the salmonids. Salmon sampling in this region will complement existing efforts to describe salmon abundance, distribution, and condition in the vicinity of the Columbia River plume (by BPA), in British Columbia (Canadian GLOBEC) and by NMFS programs further south (Gulf of Farallones) and north (SE Alaska, Auke Bay, and off Prince William Sound).

Investigators proposing to sample juvenile salmon in Oregon and Northern California should coordinate sampling plans/gear with both the CGOA salmon sampling effort and other juvenile salmon trawling efforts on the west coast (e.g., NMFS research).

Schedule and Proposal Submission

NOAA Standard Form Applications with instructions are accessible on the COP Internet Site: http://www.cop.noaa.gov/cop-home.html. The deadline for proposals is April 15, 1999 by 15:00 local time. Submit the original and two copies of your proposal to the Coastal Ocean Program office at the following address:
Coastal Ocean Program Office
(GLOBEC 99)
SSMC#3, 9th Floor, Station 9700
1315 East-West Highway
Silver Spring, MD 20910

A copy of the NOAA request for proposals (RFP) is available at http://cbl.umces.edu/fogarty/usglobec/news/globec-rfp.html, and should be consulted in responding to this funding opportunity. That document provides addresses and contact details for obtaining further technical or logistic information about applying for funds.

Specific guidelines for proposal preparation are provided in the official NOAA notice and are mandatory. Proposals received after the published deadline, or proposals that deviate from the prescribed format, will be returned to the sender without further consideration. This announcement, and additional background information, will be made available on the COP home page on the World Wide Web at: http://www.cop.noaa.gov/cop-home.html.

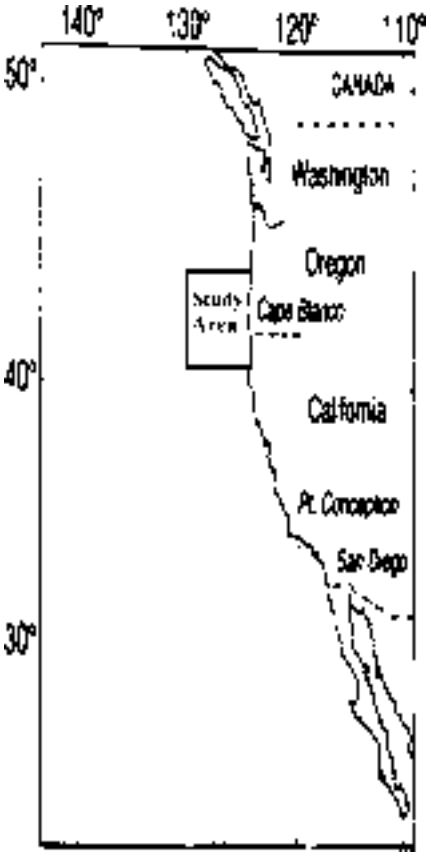
This opportunity is open to all interested, qualified, non-federal, and federal researchers. Foreign researchers must subcontract with U.S. proposers. Non-federal researchers should comply with their institutional requirements for proposal submission. Non-federal researchers affiliated with NOAA-university Joint Institutes should comply with joint institutional requirements. Proposals deemed acceptable from federal researchers will be funded through NOAA; non-federal awardees will be funded through their joint institutes, as appropriate, or through a grant from NOAA or NSF. Proposals selected for NSF funding will be required to submit additional forms and paperwork for grants processing.

Funding is contingent upon receipt of fiscal years 1999 - 2003 federal appropriations. The anticipated maximum annual funding for NEP GLOBEC activities is ca. $6-8M, which may not occur until 2001; until then the program expects increments from its current level of ca. $2.5M/yr. Of the annual total, approximately half will be devoted to CCS activities, and half to CGOA research.

Consideration for financial assistance will be given to those proposals which address one or more of the program goals listed above and and will be evaluated based on scientific merit, relevance, methodology and other criteria described in the NOAA notice.

H.B.

Northeast Pacific study area is indicated in diagram below.



Field Program Designed at Southern Ocean GLOBEC Workshop

By Eileen Hoffman and Julie Morgan

Scientists with a wide range of expertise participated in a workshop to design the U.S. field program contribution to the Global Ocean Ecosystems Dynamics (GLOBEC) Southern Ocean program and to provide guidance to the National Science Foundation (NSF) on how the U.S. may contribute to the GLOBEC Southern Ocean (SO GLOBEC) program.

The twenty scientists met with representatives from the Office of Polar Programs and the Division of Ocean Sciences on Sept. 30-Oct. 1, 1998 at the NSF in Arlington, VA. Early discussion focused on the SO GLOBEC science and implementation plans, stressing the importance of international cooperation and understanding interactions between physical forcing and biological responses in the marine environment.

Year-round studies and austral winter observations to meet SO GLOBEC objectives were emphasized, and krill (*Euphausia superba*) remains the research target species for SO GLOBEC. Workshop participants agreed upon the pressing need to understand krill ecology in the broader context of habitat preferences, feeding ecology, and interactions with its predators and competitors. Subsequent presentations at the meeting dealt more specifically with aspects of krill ecology as they are currently understood.

One workshop presentation reviewed recent studies documenting the importance of krill-sea ice interactions in structuring the Antarctic marine ecosystem. Emphasis was placed on the importance of winter sea ice as critical habitat to Antarctic krill and the significant role that salps may play as krill competitors during the non-winter months.

Next, strong linkages between the foraging ecology of Adelie penguins, krill recruitment success, and sea ice cycles in the western Antarctic Peninsula region were outlined. The extreme sensitivity of these krill predators to changes in krill availability was illustrated. Thus, the ecological dynamics of krill predators can be employed as proxy measures in field studies seeking understanding of how physical forcing cascades through the food web.

A third presentation reviewed present knowledge of the hydrography and circulation of the west Antarctic Peninsula continental shelf. The hypothesis was put forward that the mesoscale gyres now known to occur along this Peninsula shelf may serve as important krill retention areas in this region. In addition, the importance of the Circumpolar Deep Water in mediating regional-scale sea ice formation was proposed and supporting data presented. The last two presentations provided overviews of the NOAA Antarctic Marine Living Resources program and of potential interactions between SO GLOBEC and the International Whaling Commission (IWC).

Workshop participants acknowledged the apparent cohesion between the data supporting the various presentations. Participants also agreed that SO GLOBEC has the potential to provide some critical elements in our emerging understanding of ecosystem dynamics in the western Antarctic Peninsula region.

Following the presentations, workshop participants formed two working groups to focus on habitat variability and predator-prey interactions. The key science questions are noted below.

The zooplankton science questions are:

1. What key factors affect the successful reproduction of krill between seasons?

2. What key physical processes influence krill larval survival and subsequent recruitment to the adult population between seasons?

3. What are krill's seasonal food requirements in respect to energetic needs and distribution and type of food?

4. What are the geographical variations in krill distribution in relation to the between- and within-season variability in the physical environment?

The predator science questions are:

1. How does the winter distribution and foraging ecology of krill-dependent predators relate to the characteristics of the physical environment and the distribution of their prey?

2. How does summer breeding season foraging ecology relate to the abundance and distribution of the available krill population?

3. How does year-to-year variability in predator population size and breeding success relate to sea ice extent and its possible effects on krill recruitment, availability, and distribution?

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SO GLOBEC—(Cont. from page 4)

Outcomes

The two primary results of the workshop were: 1) the U.S. SO GLOBEC program will focus on winter studies and 2) the study site will be moved to the region near Marguerite Bay.

Elements of SO GLOBEC

Southern Ocean GLOBEC will focus on Antarctic krill as the primary target species, including the habitat, prey, predators, and competitors of this species. The SO GLOBEC program will be a year-round study, with emphasis on austral winter processes. Recent evidence indicates that seasonal coverage is necessary to fully understand the linkages between the environment, krill, and top predators.

Working groups dealing with questions related to Habitat Variability and Predator-Prey Dynamics met to determine the elements of studies in these critical research areas. For a report of these working groups, see http://www.ccpo.odu.edu:80/Research/globec_menu.html

Study Site

The primary field effort for SO GLOBEC is scheduled to begin in 2000/2001 and will focus on two critical sites: the western Antarctic Peninsula and Prydz Bay (70 E) regions. The western Antarctic Peninsula region will be studied through a multi-nation, multi-ship effort in order to obtain seasonal coverage, especially in the austral winter. Studies in the Prydz Bay region will be seasonal.

The U.S. contribution will be field studies in the western Antarctic Peninsula region. The International SO GLOBEC Planning Group recommended a region near Anvers Island as the field study site for the Antarctic Peninsula program. This site has both krill and krill-dependent predator populations, is subject to seasonal ice coverage, and may be a region of low advective flow.

At the U.S. SO GLOBEC workshop, it was decided to move the field study site further south along the western Antarctic Peninsula to a region in the vicinity of Marguerite Bay. The Anvers Island site could be a source of retrospective, comparative data. Careful consideration of winter predator distributions and the hydrography and circulation of the Marguerite Bay region suggest that this area would better meet the science objectives of SO GLOBEC. For example, there is evidence that large numbers of krill-dependent predators (e.g., penguins, seals, and whales) winter in the Marguerite Bay area, suggesting the presence of a dependable food source such as krill. Also, there is evidence of a recirculating gyre in this region and evidence of Circumpolar Deep Water upwelling. The latter is warmer and may produce dependable regions of open water in winter.

Some workshop participants thought that this change could compromise the international collaborations necessary to obtain the year-round coverage desired by SO GLOBEC. However, sampling nearer to Marguerite Bay will enhance cooperation with the British Antarctic Survey (BAS) and the BAS land-based station at Rothera. Winter sampling in Marguerite Bay was also an issue. An analysis of ice conditions in this region, using satellite archives, should be undertaken to establish the winter ice conditions.

Retrospective Studies

Retrospective studies need to be an integral part of SO GLOBEC. Analyses of data reservoirs, archives and as yet unanalyzed samples could provide answers to some of the questions for which multi-year data are needed. This analyses could also be used to optimize the overall experimental design associated with the single-year SO GLOBEC program by identifying the truly essential data needed to fill critical ecological gaps.

Timing of U.S. SO GLOBEC Program

The announcement of opportunity for the U.S. Southern Ocean GLOBEC program will be drafted and, after approval by the appropriate groups in the NSF, it will be released to the community in early 1999. Proposals submitted in response to this announcement of opportunity will be due at the NSF Office of Polar Programs by 1 June 1999. Peer review and NSF review of these proposals will take place during summer 1999. Awards will be made in Fall 1999 for a field program that will take place in austral winter (May-September 2001). Proposals that focus on modeling and retrospective data analysis will also be solicited as part of the announcement of opportunity.

Coordination with the International SO GLOBEC Program

The U.S. Southern Ocean GLOBEC program is part of a larger international effort. Therefore, it is important that the U.S. program be coordinated with field activities in other nations, such as Germany and the United Kingdom. This will be done through regional planning meetings to be scheduled for March to April 1999.

An important aspect of the success of SO GLOBEC is obtaining year-round coverage in a region. A tentative ship schedule (*see chart on page 6)* has been developed that will provide the needed coverage.

Other activities related to SO GLOBEC are being undertaken as part of the Modeling and Data Management working groups that have been appointed by the chair of the International GLOBEC program. These working groups include participants from the U.S. SO GLOBEC community.

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SO GLOBEC—(Cont. from page 5)

Coordination with the International Whaling Commission (IWC)

The IWC indicated that understanding climate change effects on cetaceans is an area of emphasis and has initiated linkages to programs such as SO GLOBEC. The IWC is developing a Southern Ocean Whale Ecosystem Research (SOWER) program and desires that a component of this program to be a joint field effort with SO GLOBEC. The IWC thus plans to place observers on SO GLOBEC ships to conduct tagging studies of individual whales and mesoscale surveys around the SO GLOBEC study area. The intent will be to bridge the smaller scales over which cetaceans feed with the larger scales over which cetaceans are distributed, and which are currently the subject of IWC research via the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). Some IWC funding and ship resources have already been allocated for participation in SO GLOBEC. The use of these resources will be determined in a series of planning workshops scheduled over the next year.

Coordination with CCAMLR

SO GLOBEC will take place the year following the CCAMLR Area 48 Synoptic Survey, and it is anticipated that observations, especially of krill, from this survey will be available to help plan the SO GLOBEC western Antarctic Peninsula study. Also desirable is to have CCAMLR participation directly in SO GLOBEC. SO GLOBEC will require participation by many groups and nations in order to provide year-round coverage of the western Antarctic Peninsula region. The opportunity exists for CCAMLR to provide part of this coverage and such participation would be welcome from SO GLOBEC. **E.H./ J.M.**

Proposed Cruise Coverage for Southern Ocean GLOBEC
December 2000 - January 2002

Dec. '00	Jan. '01	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan. '02
AWI	CCAMLR	CCAMLR	CCAMLR	US	US	US	US	US	US	BAS	BAS	TBA	TBA
	Coordinated by Suam Kim			Approx. 6 weeks in this 3 month period			Approx. 6 weeks in in this 3 month period						

AWI: Alfred Wegner Institute
CCAMLR: Commission for Conservation of Antarctic Marine Living Resources
US: United States Southern Ocean GLOBEC
BAS: British Antarctic Survey

International Workshop on Environmental and Climate Variations

Summary Report on the Iceland Conference Held September 1998

by Ann Bucklin and Peter Wiebe

About a year ago, members of the Icelandic Government's Ministry of Culture, Education, and Science and the Icelandic Research Council traveled to the United States for a series of meetings with officials in research sponsoring agencies (i.e. NSF, NOAA, EPA, etc) to discuss strengthening cooperative research ties between Iceland and the U.S. In part, the impetus for their visit was the European Union's recent Framework document, permitting research projects involving European and U.S. scientists. One outcome of these discussions was the organization of an international workshop on North Atlantic climate impacts hosted by the Icelandic Government. This meeting took place on 23-26 September and was attended by about 40 scientists from Europe and North America as well as as equal number of Icelanders.

The scientific discussions took place over a three-day period (a 4th day was used for an excursion around the countryside of southwestern Iceland). The presentations were broad-ranging, covering past, present, and possible future changes in the physical and biological aspects of the marine, terrestrial, and atmospheric environments of the northern North Atlantic, as well as some of the social and economic consequences. Each half-day session included three 30-minute talks and a one and one-half hour discussion period. A rapporteur was selected for each session who was asked to distill the key scientific issues emerging from the presentations and to link these, if possible, to existing inter-national programs such as CLIVAR and GLOBEC. The rapporteurs presented their syntheses during the final session. Also in the final session, representatives of U.S. and Icelandic funding agencies presented their views on areas of cooperation and development of programs, based on the scientific issues that emerged from the discussions.

Three Significant Conclusions

From our perspective, three major conclusions resulted from the meeting presentations and discussions. First, there is a significant body of data providing a basic understanding of the relationship between NAO cycles and oceanographic events (both physical and biological) in the North Atlantic. There is, however, a fundamental lack of understanding about the proximate causes of climatic variation associated with switches between high and low NAO regimes. There was a consensus that research resources and priorities should be directed towards gaining a mechanistic understanding of NAO dynamics (as we have recently achieved for ENSO events in the Pacific) in order to develop a similar level of predictive capacity for NAO events. There is a significant opportunity to use an expanded GLOBEC-type of ecosystem analysis approach for this basin-wide research initiative. This was explicitly discussed at the workshop with support and interest from many participants.

Second, the workshop reinforced recent published documentation of dramatic and abrupt *millennial-scale* cycles in atmospheric and oceanic circulation and dynamics in the North Atlantic. These cycles, driven by shifts in basin-scale circulation that occur very rapidly (years to decades), have massive impacts on climatic conditions throughout the North Atlantic, with the largest impacts centered over Iceland and Northern Europe! Currently, we have only a rudimentary understanding of these dynamics and cannot predict the shifts in ocean-basin scale circulation - much less their impact on the biological communities. Given the magnitude of potential environmental, sociological, and economic impacts resulting from an abrupt shift to a more extreme northern climate, working toward predictive understanding should become a high priority research topic. This topic area is relevant for GLOBEC-type ecosystem analysis, since it places interannual-to-decadal scale variation in context of longer-term variability. However, it remained unclear how to link the studies of these two sets of time-scales (i.e. decadal versus millennial).

Third, the workshop made clear that the technical expertise and research creativity needed to address these topics resides in all of the countries bordering the North Atlantic Ocean, with a concentration of interest - and concern - in Iceland. Any concerted approach to understanding climatic variation in the North Atlantic will require a coordinated, multi-disciplinary, and genuinely international effort. The efforts of the U.S. NSF, NOAA, and the Icelandic Research Council should be continued to ensure that this international workshop and planning effort will result in an international research program.

A second meeting, oriented toward international science policy, took place on 28 September. This meeting provided a forum for Icelandic and U.S. science administrators and scientists to convey their vision for a new era of US-Icelandic scientific cooperation. The presentations in the morning provided background on the U.S. and Icelandic science funding agency perspectives on international scientific collaboration.

The afternoon sessions focused on specific areas of collaboration which, for the most part, were non-overlapping with those distilled from the previous week's workshop. The final portion of

(Cont. on page16)

Calendar

Upcoming Meetings of Interest: 1999 - 2000

1999

Northeast Pacific Pink and Chum Salmon Workshop - Juneau, AK USA, March 3-5, 1999 Contact Sharon Hawkins, sharon.hawkins@noaa.gov

The Gadoid Stocks in the North Sea During the 60s and 70s- Fourth ICES/GLOBEC Backward Facing Workshop, March 11-13, Aberdeen, Scotland. Contact Mike Heath, MAFF, Aberdeen

ICES/SCOR Joint Symposium - "The Ecosystem Effects of Fishing." Montpelier France, March 16-19, 1999. Contact Dr. Henrik Gislason, University of Copenhagen, Charlottenlund, Denmark.

American Fisheries Society - 23rd Annual Larval Fish Conference, Beaufort, NC USA, April 6-11, 1999. Contact Johnathan Hare, jhare@hatteras.bea.nmfs.gov

U.S. GLOBEC Scientific Steering Committee Meeting - Washington, D.C., April 8-9, 1999. Contact Dr. M.J. Fogarty, Chesapeake Biological Laboratory, Solomons, MD USA.

Global Ocean Observing System Steering Committee Meeting April 26-29, 1999 Beijing, China. Contact Professor Worth Nowlin, Texas A&M University

The Oceanography Society (TOS) 1999 Scientific Meeting - "Extreme and Unexpected Phenomena in the Ocean." Reno, NV USA, April 27-30, 1999, Internet address: http://www.tos.org/reno/

Second IGBP Congress, Shonan Village, Japan, May 1-13, 1999. Contact Sheila Lunter, IGBP Secretariate, Stockholm, Sweden.

Ecological Society of America 84th Annual Meeting - "Landscapes Legacies and Limits: Bridging Borders." Spokane, WA USA August 8-12, 1999 Internet: http://esa.sdsc.edu/99announce.htm

ICES Symposium - "Population Dynamics of *Calanus* in the North Atlantic: Results from the Trans-Atlantic Study of *Calanus firmarchicus*." Tromso, Norway, August 24-27, 1999. Contact Prof. C.Miller, Oregon State University, Newport, OR USA *(For details, see pages 12-13)*

American Fisheries Society - "Integrating Fisheries Principles from Mountain to Marine Habitats." Charlotte, NC USA, August 29-September 2, 1999.

Lowell Wakefield Fisheries Symposium - "Spatial Processes and Management of Fish Populations." Anchorage, AK USA, October 27-30, 1999. Contact Breda Baxter, University of Alaska Sea Grant, Fairbanks, AK USA.

2000

AGU/ASLO 10th Biennial Ocean Sciences Meeting, San Antonia, TX USA, January 24-28, 2000, Internet: http://www.agu.org/meetings/os00call.html

ICES Symposium - "One Hundred Years of Science Under ICES." Helsinki, Finland, August 1-3, 2000. Contact Dr. Emory Anderson, NOAA / NMFS, Silver Spring, MD USA.

Northwest Atlantic Phase III Process Studies

Final Season Now Underway

by Elizabeth Turner

GLOBEC Northwest Atlantic enters into its final season of process field studies in Phase III. The objectives of the process cruises in this phase are centered on cross-frontal processes, and the program has an integrated approach to study frontal dynamics at fronts on both the Northern flank and the Southern flank. A total of 22 projects are involved in Phase III (see Table), involving 19 academic institutions, the NOAA/NMFS Northeast Fishery Science Center, 57 PIs, 44 technicians, four post-docs, and 26 students. The field cruises require over 350 days at sea, and GLOBEC is the major user of both R/V *Oceanus* and R/V *Endeavor* time in 1999. The coordination of proposals, activities, and ship time was accomplished with the input of the Phase III PIs, and their successful efforts are greatly appreciated. Energetically leading these activities has been Peter Wiebe, who will remain as the program coordinator and chair of the executive committee.

The broadscale cruises will continue to give a wider context for the process studies, with Mountain, Berrien, and Green heading up the hydrography and ichthyoplankton effort, Townsend the nutrient measurements, and Durbin macrozooplankton and nauplii work, along with an army of co-PIs, students, technicians and sorters. Longer-term, more continuous measurements will be provided by moorings and drifters deployed by Brink, Irish, and Limeburner; and in a separate project by Schlitz. Brink *et al.* will also provide analysis of historical hydrographic data to understand the physical characteristics of Georges Bank during the field studies, and fit them within a longer-term context. Bisagni will interpret and analyze remotely-sensed data, providing real-time SST frontal positions to help guide the process studies, and quantifying aspects of cross-frontal mixing from both current SST data and analysis of longer-term data. Data and samples from the broad-scale cruises will be used by Miller to model the interaction of life history events in *Calanus finmarchicus* with advection and mixing in the Gulf of Maine and on Georges Bank. Miller will also characterize and quantify developmental stages, sexual maturation, and onset of diapause in copepodites, and relate developmental delays in copepodites to starvation events. Ohman and Durbin will measure the egg-laying rate of dominant cope-pods, the growth rate of *Calanus* and *Pseudocalanus*, and estimate the egg and naupliar mortality of *Calanus* and *Pseudocalanus*.

One new addition to the program this year is the tracing of cross-frontal transport through the use of Rhodamine and Fluorescein dyes. Ledwell and Churchill will use Rhodamine WT to trace water parcels within the pycnocline and in the upper mixed layer at both the Northern flank and the Southern flank fronts. Davis will provide a view and analysis of the associated plankton populations with the Video Plankton Recorder. Houghton will use Fluorescein to track the near-bottom flow in the same areas within the same time frame. Hebert and Barth will use a Coastal Ocean Lagrangian (COOL) float, in conjunction with a SeaSoar survey, to measure cross-frontal exchange pathways at the two fronts in two separate cruises. Their project will be co-located and coordinated with the vertically-stratified zooplankton sampling of Wishner, and the microzooplankton feeding and vital rate studies of Giffford.

Certain projects focus primarily on the Northern flank, and influences of Scotian Shelf water on Georges Bank. Beardsley, Flagg and Limeburner, along with Canadian colleagues Smith, Loder, and Hannah, will examine the crossover of Scotian Shelf water onto Georges Bank, and investigate the mechanisms for transport of water, nutrients, and biota from the Gulf of Maine and the Scotian Shelf to the Northeast Peak and Southern flank of Georges Bank. Townsend and Radtke will use otolith elemental analysis and DNA micro-satellite techniques to identify the origin of larvae, with the goal of determining to what extent cod on Georges Bank are advected from Canadian waters in early developmental stages. Fairbanks and Houghton will use Oxygen-18 to assess the influence of local and far-field water sources on the Georges Bank environment.

Several process studies will work primarily on the Southern flank tidal mixing front. Bucklin and McGillicuddy will investigate the distributions of *Pseudocalanus* spp. in relation to physical transport overall on Georges Bank, but especially on the Southern flank tidal mixing front. Madin, Sullivan, and Bollens will also focus on the southern tidal mixing front to determine the distribution and abundance of prey and predators along and across the front, the effect of frontal dynamics on aggregation and interaction, and the exchange of organisms from one side to the other. They will also continue their work to measure predation rates and analyze predator gut contents. Lough, Townsend, Buckley, and Incze will use the physical data and understanding provided by the Schlitz and Chen project to interpret their studies of the interaction between water stratifica-

(Cont. on page 11)

The GLOBEC Georges Bank Phase III Program
List of PIs and Project Titles

PIs	Title
Beardsley, Limeburner (WHOI)	Frontal Exchange Processes Over Eastern Georges Bank
Bisagni (UMass Dartmouth)	Satellite-Derived Estimates of Mixing Across Sea Surface Temperature Fronts in the Georges Bank Region
Brink, Irish, Beardsley, Limeburner (WHOI)	Long Term ADCP, Moored and Lagrangian Measurements and Analysis as Part of a Georges Bank Study
Bucklin (UNH), McGillicuddy (WHOI)	Maintenance of *Pseudocalanus* spp. Populations on Georges Bank
Durbin (URI)	Abundance and Distribution of Zooplankton on Georges Bank
Fairbanks (LDEO)	Modes of Circulation and Mixing on Georges Bank: Quantifying Source Water Using the Oxygen Isotope Tracer
Franks (SIO), Chen (UGa)	Process Modeling Studies of Plankton and Larval Fish in the Tidal-Mixing Fronts
Gifford (URI), Sieraki (Bigelow)	Cross-Frontal Processes and Recruitment Variability of Georges Bank - Diet of *Calanus finmarchicus* Copepodids and Nauplii
Hebert (URI), Barth (OSU)	Cross-Frontal Fluxes and Mixing on Georges Bank
Houghton (LDEO)	Cross-Frontal Exchange Studies at the Base of the Tidally Mixed Front Using an Injected Dye Tracer
Ledwell, Davis (WHOI)	Investigation of Water-Mass Exchange Across the Tidal Mixing Front Over Southern Georges Bank and its Impact on Larval Fish and Zooplankton Populations
Lough (NEFSC), Buckley (URI), Incze (Bigelow), Townsend (UMe)	Environmental Consequences of Tidal-Front Entrainment in Larval Fish Along the Southern Flank of Georges Bank
Lynch (Dartmouth), Werner (UNC), McGillicuddy (WHOI), Lough (NEFSC)	Real-Time Data Assimilation on Georges Bank

PIs	Title
Madin (WHOI), Sullivan (URI), Bollens (SFSU)	Predation on Target Species: Role of Frontal Processes and Small Predator Species
Miller (OSU)	Growth and Development of *Calanus finmarchicus* on Georges Bank
Mountain (NEFSC), Townsend (UMe)	Broad-Scale Ichthyoplankton, Hydrography, and Nutrient Studies on Georges Bank
Ohman (Scripps), Durbin (URI)	Egg Production, Growth, and Mortality, and the Role of Frontal Processes in Copepod Population Dynamics on Georges Bank
Schlitz (NEFSC), Chen (UGa)	Physical and Biological Processes at the Tidally Mixed Front on Southern Georges Bank
Townsend (UMe), Radtke (UHi)	Origins of Cod on Georges Bank: Contributions of Early Developmental Stages for the Scotian Shelf
Werner (UNC)	Productivity of *Calanus finmarchicus* and Fluctuations in Growth and Survival of Cod and Haddock Larvae on Georges Bank: A Synthesis of Observations and Modeling
Wiebe, Groman (WHOI)	Program Services and Data Management of the Northwest Atlantic Georges Bank Program
Wishner (URI)	Cross-Frontal Distributions and Exchange of Zooplankton on Georges Bank

NW Phase III—(Cont. from page 9)

tion, tidal front processes and the transport, retention, and growth of cod and haddock larvae and their prey.

Modeling studies include Franks and Chen, who will continue to explore the influence of tidally-mixed fronts on biological production systems for Georges Bank using their primitive equation/turbulence-closure ecosystem model developed in Phase I and II. Chen will also be involved with Schlitz and Lough in the real-time simulation of observational data, initializing the model with data from their first cruise in the spring, and comparing model output to direct ADCP data from the moorings and shipboard. Ultimately, their goal is to explore the physical processes that control the temporal and spatial variation of the tidally mixed front; stratification; and along frontal and cross-frontal circulation. Werner and Runge will use a biophysical IBM to investigate the growth and survival of cod and haddock larvae on Georges Bank. They will compare the importance of variation in copepod prey field production relative to other factors influencing larval fish, including circulation, temperature, turbulence, and light. Lynch, Werner, McGillicuddy, and Lough, along with their co-workers, have an ambitious project to use real-time data assimilation during field studies, using data from Bisagni, the broad-scale cruises, and shipboard measurements to produce a circulation forecast and guide directed sampling on some process cruises.

The suite of studies in Phase III on Georges Bank are thoughtfully designed, well-coordinated, and offer tremendous potential for furthering our understanding of this vital and important ecosystem. **E.T.**

Population Dynamics of *Calanus* in the North Atlantic:
Results from the Trans-Atlantic Study of *Calanus finmarchicus*
ICES Symposium 24-27 August 1999. Tromsø, Norway*

Objectives and Scope

Large copepods of the family Calanidae constitute the bulk of marine zooplankton during late winter and spring in subpolar and polar oceans. Naupliar stages of these copepods support the larval growth of commercial fish species, particularly cod. Older stages are food for pelagic fishes, particularly clupeids. Thus, improved understanding of the ecology of *Calanus* is of practical and fundamental importance. With support from EUMAST, US GLOBEC, and GLOBEC Canada, the Trans-Atlantic Study of *Calanus finmarchicus* (TASC) programme has been seeking a great increase in ecological understanding of Calanus, with emphasis on *C. finmarchicus*.

Some components of TASC have emphasized the interaction between the population dynamics of *Calanus* and physical processes in the North Atlantic pelagic habitat. Work has been vigorous since early 1994. The goals of the symposium will be to sum up our results, to couple those results with studies of related species in other oceans, and to find directions for future research. We seek contributions in line with those goals from TASC workers and others.

Topics

Contributions will be considered for the following areas of research and for any others that authors may propose as germane to the biological oceanography of *Calanus*.

Fecundity and production:
Like those of any organism, stocks of *Calanus* increase by birth and growth. Studies of egg production in *Calanus* in field and laboratory settings have been numerous in TASC and elsewhere during recent years. Viability of eggs and early nauplii has been shown to be as important as their numbers. We seek papers quantifying the viable fecundity of *Calanus* and demonstrating the factors controlling it in the ocean. Growth in *Calanus* responds to temperature, food availability and quality, and possibly to other factors in the habitat. We seek contributions characterizing these responses.

Mortality and predation:
Estimation of mortality rates is perhaps the least developed of our skills in plankton biology, but progress is being made. We seek papers quantifying the rates of mortality of *Calanus* under various habitat circumstances and papers detailing the causes of death. Is there extensive death from genetic defects? Are parasites important? What eats *Calanus*, and how do predators rank in importance? When and where does predation drive diel vertical migration? Is there significant complementariness between distributions of *Calanus* and those of its predators?

Life history:
After TASC we will know the life history of *C. finmarchicus* in greater detail, and we should have greater insight into the correlations and causes of regional variations. We seek papers demonstrating and explaining the timing of resting and active phases in the life history, quantifying and explaining the male-to-female sex change phenomenon, and explaining why different individuals take different life history paths under similar circumstances.

Roles of flow and mixing in the habitat:
TASC studies on both sides of the Atlantic have demonstrated that different regions in the range of *Calanus* receive stocks by different means. In particular, shelf areas and enclosed basins are likely to support *Calanus* stocks only during their season of active growth. Thus, for example, interaction of flow with life history events creates the copepod reproductive hot spots that become spawning centres for cod and other fishes. We seek papers about this.

Climatic change and *Calanus* biology:
Many TASC studies have been supported on their claims that anticipated climatic changes could affect this keystone species. Time-series data indeed show that *C. finmarchicus* stocks do vary with general weather patterns and thus would vary with climate. We seek papers detailing and quantifying these relationships.

Genetic variability:
We seek papers quantifying the genetic homogeneity and/or variability across the range. By the time of the meeting the studies should show the extent to which *Calanus* is one, well-mixed population as well as the extent to which it is regionally adapted.

(Cont. on page 13)

ICES SYMPOSIUM—(Cont. from page 12)

Other *Calanus* species:
In order to compare and contrast the ecology of the target species we seek papers on other congeners in other ecosystems (*C. chilensis, C. pacificus, C. sinicus,C. agulhensis*).

Physical environment:
Several programmes have addressed water circulation features which shape and impose changes in the pelagic communities in the North Atlantic. Papers on physical oceanography on mesoscale and large scales relevant to the ecology of copepods are welcomed.

Modelling:
Modelling work could be an integral part of any of the topics listed above. We seek papers showing the results of conceptual and quantitative models of any aspect of the biology and ecology of *Calanus* in interaction with its physical and biological habitat.

Applications to environmental monitoring and management:
Sixty years ago Alister Hardy equipped North Sea herring fishermen with plankton indicators. *Calanus* on the filter disks implied good fishing waters, and some fishermen used this to improve their results. Because populations of *Calanus* are of practical significance, we invite papers proposing the appli-cation of *Calanus* biology to fishery and other ecosystem management and monitoring issues.

Structure

The symposium will feature invited presentations providing overviews of key issues in understanding of the ecology of *Calanus*. Contributed papers will be presented in sessions addressing principal topics as listed above. Posters will be displayed and special sessions will be devoted to discussing them with the authors. A session for synthesis and discussion will conclude the meeting. The presentation language of the symposium will be English.

Publication

The symposium proceedings will be published as a special issue of the ICES *Journal of Marine Science*, produced by Academic Press. Invited and contributed papers, including those based on poster presentations, will be considered for publication following peer review. Copies of the proceedings volume will be sent to symposium participants.

Date and Venue

The symposium will be held 24-27 August 1999 on the campus of the University of Tromsø, Tromsø, Norway.

Participation

The symposium is open to all scientists and students with interest in the ecology of *Calanus*. Prospective participants will receive further details and announcements with final registration forms and guidelines. Registration forms will also be available on the Internet for electronic submission.

The registration fee is US $150 (US $50 for students); for those who pay later than 1 June: US $200 (US $100 for students). The fee will include the cost of the symposium proceedings and incidentals, but not accommodation.

Co-sponsors

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ICES Backward-Facing III Workshop

by Michael Fogarty

The third in a series of workshops under the auspices of the International Council for the Exploration of the Sea devoted to retrospective analysis was held in Woods Hole during May 4-6, 1998. The convenors of the meeting were Steve Murawski (NOAA, NMFS, Woods Hole, MA), Cisco Werner (University of North Carolina) and Keith Brander (ICES GLOBEC Coordinator). The objectives of the third backward-facing workshop were to examine the interrelation-ships among recruitment patterns of gadoid stocks in the Georges Bank, Scotian Shelf, and Gulf of Maine regions of the Northwest Atlantic and to examine physical forcing mechanisms potentially affecting recruitment.

The extensive information available on recruitment fluctuations in cod and haddock populations, and the long-standing history of investigation of the physical oceanography of the region, were important factors in choosing to investigate this theme.

The historical record of fisheries for cod and haddock in the Georges Bank-Scotian Shelf region is extensive with records available for the last century. Landings of the two species have varied widely over time, and dramatic changes have occurred under heavy exploitation during the last four decades. Separating the relative effects of harvesting and environmental variation on the populations holds considerable importance in man-agement of these stocks and offers an important scientific challenge.

Several general conclusions emerged concerning changes in the physical characteristics of the system during the 1960s and 70s. A general pattern of cool water temperatures in the1960s with a concurrent subsurface freshening was evident throughout much of the region. Observations on nutrients and oxygen levels indicate lower nitrate and higher dissolved oxygen concentrations at depth in the region during this period. The cooling of the shelf waters in the 1960s is attributable to cold, fresher Labrador Slope waters off-shore that subse-quently penetrated onto the shelf. This has been linked to an inverse relation-ship between the strength of the Labrador Current's southwestward transport and the NAO index. During the 1960s the North Atlantic Oscillation (NAO) was at its lowest levels since the 1880s.

Long-term water temperature records at Woods Hole show a consistent warming trend from the 1960s through the 1990s, resulting in an overall 2° C increase. One dimen-sional energy models for the Georges Bank region have successfully described changes in stratification in response to time dependent variability of surface heating, tidal stirring and wind mixing. Interannual stratification variability is notable for waters 60 to 100m, and is greatest during summer and fall, related to variability in the inter-annual heat flux.

U.S. GLOBEC studies have indicated that since 1995 there has been a significant reduction in salinity in the water column on Georges Bank and the Gulf of Maine. Decreases in salinity between 1995 and 1997 do not appear to be related to advective effects of the Labrador Current. From fall 1997 through spring of 1998, however, cold Labrador Slope water did enter the Gulf of Maine. The temperature and salinity characteristics of these waters match closely those observed during the very cold 1960s. This input of cold Labrador Slope water is believed to be due to an increase in the transport of the Labrador Current, which may be linked to the low NAO index of the past two years.

With respect to population fluctuations of cod, a moderate degree of concordance in recruitment and survival rate among the various cod stocks was noted. The highest correlation in recruitment was between adjacent stocks in the southern extent of the area. The high coherence in annual recruitment, combined with numerical simulations showing egg and larval drift supports the possibility of interchange between the Gulf of Maine and Scotian Shelf.

For haddock, there was a moderate degree of coherence in landings, recruitment, and recruitment survival among adjacent pairs of haddock stocks. The strong 1962 and 1963 year classes in all areas suggests a common environmental factor affecting recruit-ment in those years. Decline in recruit-ment of all haddock stocks in the mid- to late-1960s generally corresponds to a reduction in shelf temperatures, along with an increase in south-westward transport along the shelf break, and a reduction in the NAO index, possibly associated with advective events. Improvements in recruitment survival in the 1970s roughly corresponded to an increase in temperatures and the NAO index.

These retrospective analyses show clear changes in the environment on decadal scales within this region. Plausible linkages of these signals with recruitment success of gadoid popula-tions have been hypothesized on the basis of these studies, providing important avenues for investigation. The broad spatial and temporal context of these studies offers an important window on climate scale events and their impact on gadoid populations.

M.F.

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GLOBEC Coordinating Office Transferred to University of Maryland

The U.S. GLOBEC Coordination Office has moved from the University of California at Berkeley to the University of Maryland, Chesapeake Biological Laboratory in Solomons, MD. The coordination office had been located within the University of California system since 1992, under the capable leadership of Zack Powell.

During his tenure as chair, Powell took U.S. GLOBEC from the drawing board to a full field program in the Northwest Atlantic/Georges Bank region. He laid the groundwork for field programs in the Northeast Pacific and in the Southern Ocean with the able assistance of Hal Batchelder as Scientific Administrator and Kay Goldberg as Office Manager. Powell now serves as interim chair of the Northeast Pacific Program Steering Committee with Batchelder in the role of Scientific Administrator for the NEP Program.

Michael Fogarty of the University of Maryland Center for Environmental Science took the chair of the Scientific Steering Committee in 1998, following Powell's two terms in office. Funding for the operation of the coordination office at the University of Maryland became available in September of last year and Linda Lagle has been hired as Office Manager. Selection of the Scientific Administrator will be announced shortly. The program office serves the Scientific Steering Committee in carrying out its functions and responsibilities of program coordination and integration.

Visit U.S. GLOBEC'S new website: http://cbl.umces.edu/fogarty/usglobec.

Iceland Workshop (Cont. from page 7)

the afternoon session was an exchange of letters intended to foster international scientific collaboration between the U.S. and Iceland. Representing the U.S. was Robert Corell, who presented a letter from Rita Colwell, director of NSF. Replying in kind with a letter of response was Vilhjálmur Lúðvíksson, director of the Icelandic Research Council. The meeting ended with a reception hosted by U.S. Ambassador Day Olin Mount and held at his residence in Reykjavik. **A.B./P.W.**

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