

# Gulf of Maine NEWS

Regional Association for Research on the Gulf of Maine

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## The Impacts of Mobile Fishing Gear on Benthic Habitat Complexity

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“...that the great and long iron of the wondyrchoun runs so heavily and hardly over the ground when fishing that it destroys the flowers of the land below water there...” Commons petition to the King of England, 1376 (cited in Graham, 1955)

“Habitat alteration by fishing activities themselves is perhaps the least understood of the important environmental effects of fishing.” Committee on Fisheries, Ocean Studies Board, National Research Council (1994)

Trawling and dredge activity occurs over large parts of the northeastern continental shelf of North America. Concern about the impacts of mobile fishing gear (e.g. trawls, dredges) on continental shelf environments began in the 14th century and continues to the present. Confusion on this issue is reflected in the fact that differences of opinion exist within the fishing and scientific communities as well as between the two groups. Fishermen disagree about the degree of damage to the seabed due

to the use of various gear types. The scientific community recognizes that fishing activity alters the bottom, but controversy exists about whether these various impacts can be interpreted to have contributed to fishery decline.

The overall impacts of mobile gear are unknown despite U.S. research efforts spanning nearly eighty years (beginning with Alexander et al. 1914). Studies of the impacts of mobile gear can be divided into two major categories: those which are concerned with a target species or one type of fishing on a target species; and those which deal with the impacts of fishing on habitat, some portion of the community, or at the ecosystem level. Studies of fishing impact on one or two target species are the most common and usually focus on valuable fisheries such as lobster, *Homarus americanus*, or sea scallop, *Placopecten magellanicus*, (e.g., Smith and Howell 1987, Caddy 1973, Shepard and Auster 1991, Jamieson and Campbell 1985, Scarratt 1973, Pringle and Jones 1980). Fishing gear impact studies at the habitat and community level are less common but ultimately may be more important in understanding the role that habitat plays in regulating survivorship of commercially important species.

Early studies often drew conclusions based on data obtained from fishermen’s reports of trawl catches; while this information was monitored by fishery scientists, researchers did not have the advantage of making direct observations in the field. Shifts in species composition and abundance were attributed to harvesting by the fishery with no connection made with other aspects at the community or ecosystem level. Alexander et al. reported that the effect of trawling on the bottom was negligible but presented little evidence in support of this conclusion. In fact, they boldly stated that “otter trawls do not seriously disturb the bottom over which they are fished not materially denude it of organisms which directly or indirectly serve as food for commercial fishes”. This statement is not surprising, given the limited state of knowledge at the time regarding community and ecosystem ecology (Auster 1988).  
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(Impacts continued)

Using fishing effort data compiled by NMFS, it is possible to estimate the area impacted by mobile fishing gear on the U.S. side of the Gulf of Maine and on Georges Bank (Fig. 1). Fishermen report catch and effort data when they unload fish at the dock after each trip and are required to report data on days fished. (Days fished is an index of fishing effort based on the time that fishing gear is in the water.) These data are summarized for trawl and scallop fisheries within each region. In this study, the width of trawls was estimated by using an average distance of 40 m between the doors for all size classes of trawler. For scallop dredge gear, 2, 4 and 6 m were used as gear widths for class 2, 3, and 4 vessels respectively. Vessel speed was assumed to be 5.5 km/hr in both fisheries. Total area fished was then calculated by multiplying days fished (24 hr/d) by gear width and vessel speed. The U.S. side of the Gulf of Maine is approximately 65,000 km<sup>2</sup> and Georges Bank is approximately 41,000 km<sup>2</sup>. Therefore, approximately all of the U.S. side of the Gulf of Maine, on a percentage basis, was impacted annually by mobile fishing gear since 1982 (Fig. 2). Between 200 and 300% of the U.S. side of Georges Bank, on a percentage basis, was impacted since 1976 (the time frame of our available data). Of course, some areas are not impacted at all and others are impacted even more frequently. We believe these to be conservative estimates.

Figure 1. Map showing regions delineated with solid lines to calculate area.

Another problem with many studies is that they have been conducted over previously fished grounds (Margetts and Bridger 1971, Caddy 1973, Gibbs et al. 1980). It is difficult to demonstrate trawling induced habitat changes if specific habitat types have already been eliminated in the study area. Recognizing this problem, recent studies have targeted areas which have both impacted and reference sites (Van Dolah et al. 1987, Riemann and Hoffmann 1991) or have sequentially surveyed a non-impacted area before and after initial dragging activities (Sainsbury 1987, Peterson et al. 1987).

Herrington (1947) was the first to make a connection between habitat complexity and production of exploited stocks. He suggested that the removal of benthic fauna such as sponges, and the overturning and burying of rocks would reduce spatial complexity of bottom habitats and affect the production of prey species utilized by target species. Peterson et al. (1987), using a manipulative field experiment, linked seagrass destruction by mechanical clam harvesting to reduced bay scallop production. The complex habitat formed by dense seagrass was directly linked to settlement density of scallops.

Tropical fish species distributions have also been linked to habitat. On the northwest Australian shelf, (Sainsbury 1987) found that golden thread, *Saurida* spp., and lizardfish, *Nemipterus* spp., occurred predominantly on open sand/"sparse" emergent

benthos bottoms, while porgies, *Lethrinus* spp., and snapper, *Lutjanus* spp., occurred in areas of "dense" emergent benthos (e.g. sponges, gorgonians, alcyonarians). Their data showed that the bycatch of sponges and associated corals fell during the course of the developing trawl fishery, eliminating "dense" habitat types. Concurrently, fauna associated with sand/"sparse" habitats increased in the catch while the "dense" associated fauna decreased. This is the first study which demonstrated a link between habitat change and catch. It is interesting to note that the species which declined had obligate microhabitat requirements.

Our own studies show that juvenile sizes of many fish species exhibit facultative associations with specific micro topographic structures (microhabitats) in low topography environments of the Southern New England continental shelf (Auster et al. 1991, 1994a, 1994b, Malatesta et al. 1992) and in the Gulf of Maine (unpublished data). Various taxa associate with structures such as biogenic depressions, shell, burrows, sand wave crests, sponges, and amphipod tubes. For example, the density of post larval silver hake, *Merluccius bilinearis*, increased as cover provided by amphipod tubes increased. Also, there are groups of species (e.g. *Raja* spp.) which produce features such as depression and those (e.g. squid, *Loligo pealii*, scup, *Stenotomus chrysops*) that utilize the depressions produced by others. While use of these features is not obligate, the association of many taxa with various feature implies that there is some increase in individual fitness.

Figure 2. Area impacted by mobile fishing gear on the U.S. side of the Gulf of Maine (left) and Georges Bank (right).

We have just completed a project conducted at a site in the northern Gulf of Maine which demonstrates that the use of mobile fishing gear can reduce habitat complexity in low topography environments. An ROV was used to conduct quantitative survey transects to evaluate differences in habitat complexity and faunal-habitat relationships in a conservation area (i.e. no mobile gear) and adjacent fished sites. Analysis of our data showed significant reductions in the cover provided by emergent epifauna (e.g. hydroids, bryozoans, sponges, holothurians) on cobble-shell substrates. In addition, there were measurable decreases in microtopographic features (e.g. biogenic depressions) on sand-shell substrates which were attributed to reductions (i.e. through harvesting activities) in the number of individuals which produce such features through foraging and shelter seeking activities.

Laboratory studies have demonstrated that the use of various microhabitat features can play a functional role in enhancing juvenile survivorship. In the presence of a predator, juvenile cod, *Gadus morhua*, survivorship was enhanced by a shift in their substrate preference from sand or gravel-pebble to cobble (Gotceitas and Brown 1993). Individuals used the interstices of the cobble substrate to seek refuge from predation. This work illustrated that even subtle changes in habitat complexity can have an effect on predation pattern. Behavioral responses to increased habitat complexity have been shown to increase survivorship at early ontogenetic stages of American lobster, *Homarus americanus* (Wahle 1992, Wahle and Steneck 1992).

We posit that trawl and dredge gear may have profound impacts on survivorship of a variety of species, especially at post larval and juvenile stages, due to alterations in microhabitat availability. Fishery reserves may ultimately serve as an effective tool for managing fishing effort from a habitat perspective (Auster & Malatesta 1994c). However, more research is required to determine levels of impacts on a wider range of substrate and the effect of various levels of fishing effort on habitat structure in order to provide fishery managers with better information regarding actions targeted at restriction of mobile gear use.

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### NOAA Coastal Ocean Program Predation Process Cruises on Georges Bank

Michael J. Fogarty, National Marine Fisheries Service, Woods Hole

Several cruises were undertaken during 1994 to refine our understanding of the role of predation in recruitment dynamics of Atlantic cod and haddock on Georges Bank. The timing of the cruises and the location of the sample sites was keyed to known distribution patterns of the early life stages of cod and haddock on the bank during the first year of life. Previous research showed that predation on fish larvae is episodic and depends on chance encounters between patches of larvae and schools of predators. Accordingly, we chose study sites with a high probability of co-occurrence of cod and haddock larvae (Figure 1) and known predators of these species. The cruises were part of a broader program funded under the NOAA Coastal Ocean Program with the objective of examining the joint effects of predation and harvesting on fish community dynamics on Georges Bank. This program complements GLOBEC studies in the Northwest Atlantic.

The first cruise, comprising two parts, was conducted during May 2-13 and May 16-27 aboard the R/V Delaware II on the southern flank of Georges Bank. This cruise was conducted concurrently with two GLOBEC cruises in the same area. Nektonic predators were collected using a standard No. 36 Yankee otter trawl with 1 cm mesh in the cod end to retain small individuals. Tow duration was 30 minutes. A random sample of target predators, stratified by length, was selected for stomach content analysis. We established a two-tiered priority list of predator species based on previous diet analyses indicating whether larval fish were important in the diet. Stomach contents of high priority species were excised and preserved for laboratory examination while lower priority species were examined at sea. Subsamples of stomach contents were also collected and stored in liquid nitrogen for subsequent testing with polyclonal antibody and DNA-based probes to detect predation on cod and haddock in well-digested remains where visual identification was not possible. Plankton samples were collected at each station using 60 cm bongo nets with 505 and 333 micron mesh to permit location of concentrations of cod and haddock larvae and to examine patterns of feeding selectivity of predators. Seabird CTD casts were made at each station.

702 samples from eight high priority species, including Atlantic herring, mackerel, longfin and shortfin squid, were preserved for laboratory analysis of stomach contents. An additional 2007 stomach samples comprising fourteen predator species, including silver hake, spiny dogfish, and four-spot flounder, were examined at sea; prey was determined volumetrically to the lowest possible taxon. Stomach content samples were stored in liquid nitrogen for polyclonal antibody analysis (N=521) and DNA-based analyses (N=507). An additional 704 and 698 samples, obtained in plankton sampling, were stored in liquid nitrogen for cross-reactivity studies for the polyclonal antibody and DNA studies.

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*Figure 1. Generalized distribution of cod/haddock eggs (1), larvae (2,3), and pelagic juveniles (4,5) during their first 3-4 months of life in the clockwise circulation over Georges Bank. Cross hatching indicates where highest abundance of recently-settled juveniles (6) may be found in mid summer. The arrows represent the direction and relative speed of mean subsurface flow. (Courtesy of R.G. Lough, NMFS)*

The second cruise was made during June 20-30 aboard the R/V Delaware II on the western portion of Georges Bank. Sampling protocols were as above except that tow duration of the trawl component of the study was reduced to 15 minutes and all stomachs were processed at sea. Stomach contents of twenty predator species (N=2,483) were determined volumetrically to the lowest possible taxon. Stomach samples were numerically dominated by spiny dogfish, Atlantic herring, silver hake, longfin and shortfin squid. Subsamples from 198 stomach contents were collected and stored in liquid nitrogen for polyclonal antibody and DNA-based probes. An additional 119 samples were collected for cross-reactivity analysis.

The third cruise, aboard the R/V Albatross IV, was made during August 22-September 2 on the Northeast peak of Georges Bank. Sampling protocols were identical to those in the first cruise with a shift in focus to demersal predators. A total of 820 predator stomachs of twelve species, including winter skate, little skate, silver hake, four-spot flounder, longhorn sculpin, and cod (larger cod are piscivorous and also cannibalistic) were pre-

served for subsequent laboratory processing. Stomach contents of an additional 964 individuals of twenty-two species were examined at sea. Subsamples of 33 stomach contents were preserved in liquid nitrogen for testing with biochemical probes.

Following work-up of preserved samples, information derived from these cruises will be used to determine daily consumption rates of key predators with special emphasis on predation on fish (particularly cod and haddock). A similar cruise schedule will be implemented in 1995 to replicate the 1994 study. These cruises will be coordinated with GLOBEC cruises during this time period. Consumption estimates derived from these and previous studies will be used in several multispecies models currently under development with the objective of determining the effects of harvesting on the abundance, production, and community composition of fishes on Georges Bank. The ultimate goal is to provide ecosystem-based scientific advice to fishery managers as rebuilding of groundfish stocks is undertaken on the northeast continental shelf.

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## Commerce Department Moves to Save Fish off New England; Shuts Down Parts of Georges Bank to Fishing

Scott Smullen, NOAA, National Marine Fisheries Service

The Commerce Department took emergency action on December 7th to close portions of U.S. waters of Georges Bank and southern New England to commercial fishing to save such species as cod, haddock and yellowtail flounder from economic extinction. The action, recommended by the New England Fishery Management Council, closed areas of Georges Bank and southern New England waters off Massachusetts to all fishing through March 12, 1995. The emergency action also prohibits New England fishermen in other areas from using fishing nets with mesh sizes smaller than six inches, unless it has been determined that little harm to the regulated groundfish resource will occur.

Similar fishing restrictions on area and time closures were scheduled to take effect as part of an earlier fisheries conservation and management package implemented in January 1994. However, the conservation measures of the so called Amendment 5 package did not include enough protection to halt the rapid decline of the groundfish stocks in the region. Therefore, the Council developed today's emergency restrictions based on the latest stock management data that were not available when Amendment 5 was implemented.

The New England area closures and net restrictions are aimed at helping maintain stocks of cod, haddock and yellowtail flounder and prevent further state of collapse caused by years of severe overfishing. The 18th Stock Assessment Report issued to the New England Council in August concluded that the haddock and yellowtail flounder stocks had virtually collapsed and that cod numbers were lowest on record and the stock faced almost certain destruction.

The emergency restrictions may be continued an extra 90 days beginning in March to allow time for the New England Fishery Management Council to develop a long-term plan to rebuild the area's groundfish stocks. The council is now working on an amendment to the current groundfish plan that may include a further moratorium on fishing in the area.

The New England Fishery Management Council is one of eight regional groups established by the Magnuson Fishery and Management Act of 1976 to prepare fishery management plans for marine fish stocks in their respective geographical areas. The management plans are submitted for review by NOAA's National Marine Fisheries Service, and approved by the Secretary of Commerce.

Management advice provided by fisheries scientists last summer concluded that stocks of Georges Bank haddock and Georges Bank and Southern New England yellowtail flounder have collapsed, and that the Georges Bank cod stock is close to collapse, as described below. This advice led in part to the emergency action by the Secretary of Commerce.

Scientists further concluded that, without reductions in fishing mortality, cod and yellowtail flounder will not be able to rebuild, and cod will collapse. They recommended fishing mortality reductions of 60 percent for cod and 52 percent for yellowtail flounder just to maintain current low population levels; and reductions to as low as level as possible, approaching zero, if stocks are to recover. These three stocks have traditionally supported the Georges Bank groundfishery. In the Northeastern region as a whole, stocks of cod, haddock, and yellowtail flounder on Georges Bank, in the Gulf of Maine, and in Southern New England are at record low levels. Several other groundfish stocks are at low levels as well.

A "collapsed" stock has the following characteristics: so few spawning individuals remaining in the stock that there is little likelihood of strong spawning (i.e., large year classes); an abnormally small number of older fish in the stock, and prolonged periods during which the stock yields less than 25% of the maximum sustainable yield (MSY). These conditions in a stock result in chronic low recruitment and continued low stock numbers, and the stock can be described as "collapsed".

For comparison, scientists have determined the MSY of cod, haddock, and yellowtail flounder on Georges Bank area to be 98 thousand metric tons (mt). The yield in 1993 was 29.6 thousand mt, or 30% of the MSY. Yields in 1994 are projected to decline further to 22.9 thousand mt, or 23% of MSY. The required spawning stock biomass (SSB) to support the MSY of these species on Georges Bank is about 300 thousand mt. Presently, the SSB is estimated to be 39 thousand mt.

### New England Groundfish Scientific Information

Total Commercial Landings (Thousands of Metric Tons)

Species	1982	1993*
Georges Bank Cod	57.2	23.1
Georges Bank Haddock	18.2	4.4
Yellowtail Flounder		
Georges Bank	10.6	2.1
Southern New England	10.3	0.5

\* 1993 data remain provisional.

**The Emergency Rule** The emergency action affecting the Northeast Multispecies Fishery was requested by the New England Fishery Management Council on Nov. 1, 1994. The New England Fishery Management Council is presently developing an amendment to the Northeast Multispecies Fishery Management Plan, which will contain new measures to restrict harvests further, in order to avoid additional stock collapses and to improve prospects for rebuilding groundfish stocks in general. The Council's amendment is expected to be completed by Summer 1995.

These measures will provide some refuge and protection for the principal commercial groundfish species on Georges Bank and in southern New England and, to a lesser extent, in the Gulf of Maine. The measures are expected to reduce the harvest of these species as a whole and help stabilize the resource.

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## Huntsman Marine Science Centre site for St. Andrews Ecological Science Center

John Allen, Huntsman Marine Science Centre

Huntsman Marine Science Centre (HMSC) has been selected to coordinate one of twelve Ecological Science Centres (ESC) across Canada for the National Ecological Science Network. Each center will serve as a scientific cooperative, to enhance joint monitoring and research concerning the long term changes in the coastal, marine and terrestrial ecosystems. Huntsman is situated on Brandy Cove at the mouth of the St. Croix estuary in St. Andrews, New Brunswick, alongside the Biological Station of Fisheries and Oceans Canada with which HMSC shares many facilities. Scientists from the Biological Station as well as from other universities and government are participating in the formation of the ESC. The St. Andrews Centre will focus on long-term ecosystem coastal monitoring. Two working groups have already been formed: to establish the framework to develop appropriate marine biodiversity protocols in a number of areas, and to look at the impact of heavy metals on biota (initial programs will study accumulations in birds, aquatic mammals, fish and bivalves). A local, autonomous scientific steering committee will promote interdisciplinary studies on global, national, regional and local environmental issues. The committee has already met but new members are being added to provide the necessary scientific and regional breadth.

Huntsman was created in 1969 when a consortium of universities in Eastern Canada pooled their resources to provide field research and teaching facilities to complement their programs in marine biology and oceanography. The HMSC mission is to provide the leadership necessary to achieve understanding and effective management of the coastal environment through research and education. Current member institutions include: Univ. of Guelph, Univ. de Moncton, McGill Univ., Mt. Allison Univ., Univ. of New Brunswick, Univ. of Toronto, Univ. of Waterloo, Univ. of Western Ontario, Education New Brunswick, Fisheries and Oceans Canada, and New Brunswick Fisheries and Aquaculture. The HMSC provides access to a variety of aquatic and terrestrial environments, freshwater and saltwater animal holding facilities, and large wet and dry research and teaching laboratories. HMSC offers a year-round teaching and research facility for pure and applied marine science. Research projects currently underway include studies of flat fish aquaculture, engineering problems associated with cage technology, and environmental impact of salmon aquaculture cages on the biodiversity of the benthos underneath. Other studies include work on development of marine organisms, marine parasitology, flatfish population modeling, insect biodiversity streams, and warbler and songbird population dynamics.

The Atlantic Reference Centre is a significant and unique zoological/botanical museum collection of aquatic organisms, operated cooperatively by HMSC and Fisheries & Oceans Canada. It provides systematic and ecological expertise and information on fishes, invertebrates, parasites and algae of Atlantic Canada.

## The East Coast of North America Strategic Assessment Project completes first year of Pilot

Mike Butler, Oceans Institute of Canada

Steve Brown, Strategic Environmental Assessments Div., NOAA

The East Coast of North America Strategic Assessment Project (ECNASAP) began an 18 month pilot study in January 1994. The ECNASAP participants compile existing data sources and synthesize comprehensive region-wide data bases and maps to address specific marine resource management issues. The key coordinating organizations within Canada and the U.S. respectively are the Atlantic Coastal Zone Information Steering Committee (ACZISC) and the Strategic Environmental Assessment (SEA) Division of NOAA.

The **Inshore Case Study** was initiated due to concern over the continuing decline in the quality of shellfish waters. The study area is the coastal zone of the Gulf of Maine and the Bay of Fundy. The overall goal is to use shellfish beds as indicators of the status of coastal resources and pollution problems. There are two project components: the identification of current and potential shellfish production areas in the coastal area through an updated Gulf of Maine Shellfish Register; and the identification and assessment of point and non-point sources of land based pollution through the development and application of Condition-Stress-Response methodology.

The Gulf of Maine Shellfish Register is a joint project involving existing Canadian and U.S. programs that assess trends in the harvest status of classified shellfish waters in estuaries. Information on molluscan shellfish are being developed through interviews with state and provincial authorities and analysis of their data on shellfish bed closures, water quality, harvest, etc. Information is also being developed on aquaculture production. This is an extension into Canada of similar analyses that have been conducted as an ongoing SEA Division program at five year intervals for the entire U.S. The Gulf of Maine *Shellfish Register* should be available by June 1995. SEA Division and Environment Canada are the primary sponsors and participants; contact Dorothy Leonard at SEA (301)713-3000 and John Machell at Environment Canada (902)426-4570 for more information.

The Condition Stress Response (CSR) component of the Inshore Case Study is being conducted primarily by Environment Canada. Joe Arbour (902)426-1701 is the primary architect of the CSR concept and of its application. "Condition" refers to the harvest status of shellfish beds; "Stress" refers to the factors identifiable as causing the problems encountered in the shellfish beds (such as closure due to fecal coliform contamination) and "Response" refers to remedial options for improving the shellfish bed condition. The study area is southwestern New Brunswick, the Passamaquoddy-St. Croix-LeTang region. The CSR project focuses on estuarine and coastal shellfish as indicators of land-based point and nonpoint source pollution.

(continues on page 8)

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(ECNASAP continued)

The CSR project is now in the early stages of design and data compilation. Digital and hardcopy maps are being developed on shellfish resources, including species, area, harvest status; land use; and environmental characteristics, (climate, hydrography, water quality, circulation and pollutant dispersion, and soils). Point pollutant sources will be obtained from the Gulf of Maine CME Program's point source inventory, initially developed by the SEA Division. A screening tool, being developed by Environment Canada and the Technical University of Nova Scotia, will be used to assess vulnerability to nonpoint source pollution.

A workshop is being planned for March 1995 in St. Andrews, to better define methods of data interpretation and to develop options for remediation. A final report is planned for spring 1996.

The **Offshore Case Study** is being conducted by DFO, Environment Canada, and NOAA's SEA Division. Bob O'Boyle at DFO (902) 426-4890 and Steve Brown at SEA (301) 713-3000 are the principle contacts. The primary focus is on identifying and mapping key species and demersal assemblages, and assessing how changes in water temperature affect assemblage distributions. Associations of demersal and semi-demersal species will be analyzed using multivariate analysis of species occurrence in research trawl surveys. Additional components of the study include compilation and mapping of the relevant coastline, bathymetry, temperature (average and variability) and sediment type. This information will be used to determine the characteristics and main boundaries of the Continental Shelf demersal communities, and examination of changes in the communities over time and space.

Habitat suitability models will be developed for key species and assemblages, to assist in the completion of maps in unsampled areas, in the identification of key habitats, and to test predictions of distributional changes as a function of temperature changes. The information described above will be used to support these analyses.

The geographic scope of this project extends from Cape Breton, Nova Scotia, to Cape Hatteras, North Carolina, with the inshore boundary at the 20 metre isobath and the offshore boundary defined by the 200 mile limits of the U.S. Exclusive Economic Zone and the Canadian Exclusive Fisheries Zone. Project completion is planned for fall 1995.

A detailed history of ECNASAP's development is contained in three documents, available from the ACZISC Secretariat Mike Butler (902) 494-1977 or NOAA/SEA Division Chief Dan Basta (301) 713-3000. Additional information is available in the proceedings of the Coastal Zone Canada '94 Conference (Halifax, NS, Sept. 20-23, 1994).

#### **NOAA's Strategic Environmental Assessment Division**

The SEA Division develops the information needed for integrated coastal management, and makes the information available to managers in forms such as reports, regional and national atlases, and desktop and geographic information system products. The focus is often on relatively large regions, such as the East Coast of North America.

SEA staff are involved in a number of projects, other than ECNASAP, that include the Gulf of Maine region. The **Estuarine Living Marine Resources program** compiles information on the distribution, abundance, and life history characteristics of fishes and invertebrates in the Nation's estuaries. The **Gulf of Maine's point source inventory** is currently being updated and a method for estimating non point sources in the region is being developed. **Habitat suitability models** for eight estuarine fish and invertebrate species in Casco and Sheepscot Bays are being created in collaboration with the U.S. Fish and Wildlife Service's Gulf of Maine Project. The **Coastal Assessment Framework** is a digital set of spatial areas encompassing nearly 83 percent of the land area within the contiguous U.S. and includes the drainage basins of nearly all of the Nation's rivers. The framework is available as a set of digital files. Contact Peter Grose, Chief of Data Management and Geographic Information System Group. **COMPAS** is a desktop information management system for coastal resources that integrates NOAA and state information with query, mapping and analytical capabilities. Three projects have been completed in Texas, Florida, and Oregon, with the goal of creating a generic COMPAS product. The software is structured around ORACLE; a product for Apple Macintosh is now available. Once the generic COMPAS is on-line, NOAA will provide the necessary user support assistance. Contact John Paul Tolson (301) 713-3000 for more information. A number of other nation-wide databases which include the Gulf of Maine are managed at the SEA Division, such as the Shellfish Register, Estuarine Living Marine Resources, National Coastal Pollutant Discharge Inventory and a pesticide use survey.

#### **Oceans Institute of Canada**

The Oceans Institute of Canada (OIC) is a private non-profit corporation that provides research, technical assistance and training in all sectors of integrated oceans policy and management. OIC projects focus on issues in oceans transportation, safety and security, the environment, fisheries, aquaculture, non-living resources development, and the coastal zone/coastal community. The OIC manages projects on a contract basis in Canada and abroad, with additional project team expertise provided by OIC Associates from the private and public sector. For example, the OIC coordinates the ECNASAP, the joint Canadian-U.S. initiative described in the previous article.

The OIC office is headquartered in Halifax, Nova Scotia. At that location, it is also the headquarters for the **Atlantic Coastal Zone Information Steering Committee** (ACZISC), mandated by the Council of Maritime Premiers to coordinate the development of a regional coastal zone information infrastructure. The ACZISC compiles an Atlantic Coastal Zone Database Directory which contains over 612 database descriptions of relevance to the coastal zone of Atlantic Canada. The majority of these databases reside within federal and provincial governmental departments. The database directory is distributed by the ACZISC Secretariat in WordPerfect 5.1 and Paradox formats. Contact Claudette LeBlanc (902) 494-1977 for more information.

## U.S. GLOBEC Georges Bank Data Management and 1995 Field Work

Robert C. Groman, Woods Hole Oceanographic Institution

The U.S. GLOBEC Georges Bank program uses the Joint Global Ocean Flux Study (JGOFS) software to address its distributed data storage and retrieval needs. This software was developed by Glenn Flierl, James Bishop, David Glover, and Satish Paranjpe. The JGOFS software provides its own XWindows based software to retrieve and display data contained in its (distributed) database. This is described in the *Data & Information Systems Workshop Proceedings*, D.K. Phelps, et al. eds., RARGOM Report #93-1, 1993, pgs. 28-38.

JGOFS also supports another method to look at, retrieve and plot the information via the World Wide Web (WWW). A WWW browser, such as Mosaic, can be used to look at all the publicly available data as well as related documentation and reports. The program's home page is <http://globec.whoi.edu/globec.html>. This home page provides further information about the program, JGOFS software, ships' schedules; and, as data become available, access to the data. We are just beginning to add data to the system so there is little data available on-line. But the 1995 field season has 25 cruises planned on three ships and data will be added as soon as they become available.

### U.S. GLOBEC Georges Bank 1995 Field Program Summary.

dates	vessel	purpose, chief scientist
Oct. 25, 1994 - Nov. 2		R/V Endeavor long term mooring deployment Jim Irish (508) 457-2000 x.2732
Nov. 7-18	R/V Albatross IV	broad-scale survey, David Mountain (508) 548-5123
<b>January 1995</b>		
9-21	R/V Endeavor	process / zooplankton Ted Durbin (401) 792-6695
29-Feb. 7	R/V Endeavor	process / mooring, Bob Weller (508) 548-1400 x.2508
<b>February</b>		
10-20	R/V Endeavor	broad-scale survey, Peter Weibe (508) 457-2000 x.2313
23-Mar. 10	R/V Endeavor	process / zooplankton, Cabell Davis (508) 548-1400 x.2333
<b>March</b>		
13-24	charter vessel	process / larvae, Greg Lough (508) 548-5123
16-27	R/V Endeavor	broad-scale survey, Charlie Miller (508) 737-4524
27-Apr. 4	charter vessel	long term mooring turn-around Jim Irish (508) 548-1400 x.2732
27-Apr. 8	R/V Endeavor	process / zooplankton, Scott Gallager (508) 548-1400 x.2783
<b>April</b>		
7-22	charter vessel	process / larvae, Greg Lough (508) 548-5123
12-24	R/V Endeavor	broad-scale survey, David Mountain (508) 548-5123
24-May 3	charter vessel	turbulence, Neil Oakey (902) 426-3147

26-May 9	R/V Endeavor	process / zooplankton Dian Gifford (401) 792-6818
<b>May</b>		
8-19	R/V Albatross IV	broad-scale survey John Sibunka (908) 872-3000
8-26	charter vessel	process / larvae Greg Lough (508) 548-5123
22-Jun. 21	R/V Endeavor	process / zooplankton Ted Durbin (401) 792-6695
<b>June</b>		
4-16	R/V Albatross IV	broad-scale survey Ann Bucklin (603) 862-0122
5-15	charter vessel	turbulence Neil Oakey (902) 426-3147
25-Jul. 7	R/V Endeavor	predators, Larry Madin (508) 548-1400 x.2739
<b>July</b>		
10-15	R/V Endeavor	process / mooring, Sandy Williams (508) 548-1400 x.2725
10-21	R/V Albatross IV	broad-scale survey, Peter Weibe (508) 457-2000 x.2313
<b>August</b>		
21-28	Oceanus	stratification mooring recovery Bob Beardsley (508) 548-1400 x.2536
<b>September</b>		
7-15	R/V Endeavor	process / mooring, Steve Lentz, (508) 457-2000 x. 2808
27-Oct. 3	R/V Endeavor	long term mooring recovery Jim Irish (508) 548-1400 x.2732
<b>November</b>		
tba	R/V Albatross IV	long term mooring deployment Jim Irish (508) 548-1400 x.2732

## A Nutrient Hydrography Database

A Nutrient Hydrography Database for the Gulf of Maine is now available for researchers. It will be sent as a DOS-formatted disk with the data files and a one-page set of instructions. There is no charge. The database was prepared by C. Garside, M.D. Keller and M.E. Sieracki, at the Bigelow Laboratory. This work was supported by the Regional Marine Research Program. Anyone wishing a copy should write to David Townsend at RMRP, 14 Coburn Hall, University of Maine, Orono, ME 04469.

## The Coastal Ocean Processes Program Distributes its first Newsletter

A CoOP newsletter has been started to inform the ocean science community of current and planned CoOP activities. CoOP is a broad-based program in coastal oceanography. The newsletter will be published periodically by the CoOP program and edited by Jane Hawkey. If you would like to be on the mailing list, please send you name and address to: Coastal Ocean Processes Office, Horn Point Environmental Lab, University of Maryland, P.O. Box 775, Cambridge, MD 21613 or via Internet: [hawkey@hpel.umd.edu](mailto:hawkey@hpel.umd.edu).

## Publications Noted

### Reports Received

- The following reports have been received at the Association office and are available for distribution by contacting the author.
- East Coast of North America Strategic Assessment Project*, Joint Canada-USA Pilot Project Workshop, BIO, Dartmouth, Nova Scotia, 13-15 Jan., 1993, Workbook, ACZISC and NOAA, 72 pgs.
- Irish, J. and Martin, A., "R/V Iselin Cruise CI9405 Woods Hole to Georges Bank to Woods Hole": U.S. GLOBEC NW Atlantic Georges Bank Study, May 7-10, 1994
- Irish, J., Martin, A., and Racine, B., "R/V. Endeavor Cruise EN246 Narragansett to Georges Bank to Woods Hole": U.S. GLOBEC NW Atlantic Georges Bank Study, 28 June - 1 July, 1994
- Irish, J., Martin, A., "R/V. Endeavor Cruise EN256 Woods Hole to Georges Bank to Woods Hole": U.S. GLOBEC NW Atlantic Georges Bank Study, 26-31 October, 1994
- Jury, S.H., J.D. Field, S.L. Stone, D.M. Nelson, and M.E. Monaco, 1994. *Distribution and Abundance of Fishes and Invertebrates in North Atlantic Estuaries*, ELMR Report No. 13, NOAA/NOS SEA Div., Silver Spring, MD, 221 pgs.
- Habitat Suitability in Casco and Sheepscot Bays*, Pilot Study Proposal, Gulf of Maine Project, U.S. Fish & Wildlife Service, U.S. Dept. of Interior, and SEA Div., NOAA, Aug. 1994.
- Harding, G. ed., Evaluation of GULFWATCH 1992, Second Year of the Gulf of Maine Environmental Monitoring Plan, June 1994, The GoM Council on the Marine Environment, 141 pgs.
- Horgan, E. and Madin, L., eds., "R/V Albatross IV Cruise 9403 Part I Woods Hole to Georges Bank to Woods Hole": U.S. GLOBEC NW Atlantic Georges Bank Study, May 3-13, 1994
- Pacheco, P.A., *Gulf of Maine Point Source Inventory*, The National Coastal Pollutant Discharge Inventory, A Summary by Watershed for 1991, Feb. 1994, Pollution Sources Characterization Branch, NOAA/NOS SEA Div., Silver Spring, MD, (301) 713-3000.
- "R/V Albatross IV Cruise 9403 Part II Woods Hole to Georges Bank to Woods Hole": U.S. GLOBEC NW Atlantic Georges Bank Study, May 17-28, 1994
- Restoring and Protecting Marine Habitat, The Role of Engineering and Technology*, Committee on the Role of Technology in Marine Habitat Protection and Enhancement, Marine Board, Commission on Engineering and Technical Systems, National Research Council, National Academy Press, Washington, D.C., 1994
- Smith, R.L., and Brink, K.L., *Coastal Ocean Processes: Wind Driven Transport Processes on the U.S. West Coast: Portland, Oregon Workshop, July 14-16, 1993*, CoOP Report No.4, Sept. 1994, WHOI Technical Report, WHOI-94-20, 140 pgs.
- Stevenson, D., and Braasch, E., eds., *Gulf of Maine Habitat: Workshop Proceedings*, RARGOM Report No. 94-2, 146 pgs.
- Strategic Assessment Publications List*, Katz, M.J., (ed.), Winter 1994, NOAA/NOS SEA Div., Silver Spring, MD, 12 pgs.
- Townsend, D.W., Brown, J.F., and Cucci, B.E., *Oceanographic Conditions During Spring on Georges Bank and in the Gulf of Maine: Results of R/V Columbus Iselin Cruises: 20-29 April, 1993, 17-26 May, 1993, 7-15 April 1994, 12-20 May, 1994*, Aug. 1994, Univ. of Maine, Dept. of Oceanography Tech. Rep. No. 9401, 157 pgs.
- U.S. Dept. of Commerce, *The 1990 National Shellfish Register of Classified Estuarine Waters*, NOAA, July 1991.
- Wright, L.D., et al., *Coastal Oceanography: Future Trends and Vessel Requirements*, Coastal Oceanography Subcommittee of the UNOLS Fleet Improvement Committee, June 1994, 29 pgs.

## Resources

### Grants / Sponsored Research

**NSF: The National Science Foundation Division of Ocean Sciences Research Section has announced a change in Target Dates for 1995 to Feb.15 and Aug. 15.**

**Div. of Environmental Biology**, Dr. James Estes, (703) 306-1483, **Deadlines: May 8, S19-1042, Biotic Surveys & Inventories**

This program supports research to record and document the diversity of life on earth, both past and present, as a prologue to investigations of patterns and processes and the development of plans for conservation of that diversity. Proposals should involve collecting specimens of extant and extinct organisms as samples of taxa of geographic or oceanographic regions and/or geologic horizons; conducting inventories of existing collections; developing and disseminating electronic databases of the collected or inventoried specimens and taxa; and producing biotic treatments, authenticated species lists, catalogs, manuals, keys, expert identification systems, and/or other documents in electronic and printed form. See NSF 94-66 for additional information.

**Div. of Networking and Communications Research and Infrastructure**, Mr. Daniel Van Belleghem, (703) 306-1949, **Deadlines: Mar. 1, July 1, S19-1139, NSFNET Program**

All U.S. academic institutions with scientific and engineering research and education programs are invited to submit proposals to connect to the NSFNET which provides for remote access to NSF supported supercomputer centers. Through the program individual institutions are connected to a mid-level network in the appropriate geographical region which is in turn attached to a high-speed national backbone network. See NSF Announcement 93-7 for further information.

**NOAA/NWS/OH/Hydrologic Research Laboratory, Silver Spring, MD, Dr. Danny Fread, Deadline: Feb. 1, S19-1264, 1995 NOAA Colloquium on Operational Environmental Prediction**

The NOAA will sponsor a four-week colloquium for graduate students on operational environmental prediction to be held at the NOAA Science Center, Camp Springs, Maryland, from June 5 -30, 1995. The colloquium will consist of a series of lectures, interactive workshops and demonstrations on various aspects of environmental prediction conducted at NOAA, and afford opportunities for discussions with NOAA scientists. The lectures will include the following topics: climate monitoring and prediction, weather analysis and prediction, hydrologic prediction, oceanographic prediction and coastal ocean processes, satellite products for numerical weather prediction and global change studies, living marine resources, and space environment prediction.

**U.S. GEOLOGICAL SURVEY, Reston, VA, Jennifer Snyder, (703) 648-5514, or Nedra Stallone (703) 648-7364, Deadline: Feb. 15, S19-1281, National Spatial Data Infrastructure (NSDI) Competitive Cooperative Agreements Program Announcement 8110**

The NSDI Competitive Cooperative Agreements Program is intended to encourage resource-sharing projects between and among the public and private sector through the use of technology, networking, and enhanced interagency coordination efforts for geospatial data. Proposals must involve two or more organizations, and participants are expected to cost share in the project. Activities initiated under this program will promote access to data sets that are needed for national, regional, state, and local analyses. Under this FY 1995 program announcement, proposals are to be directed towards two components of the NSDI: the first component deals with creation of a distributed clearinghouse for finding and accessing geospatial data; the second component involves development and promulgation of the use of standards in data collection, documentation, transfer, and search and query.

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## Internet Corner

*This month inaugurates a new column concerning the Internet. It is intended to present facts, explain jargon and acronyms, etc. in a simple forum. Suggested topics for discussion can be emailed to the author, Jim Waugh, at jim.waugh@dartmouth.edu, or the editor, Genie Braasch, at braasch@dartmouth.edu.*

**What is the Internet (note the capital “I”)?** The Internet is the largest network in the world. It is often referred to as a “network of networks”. It is comprised of thousands of separately administered networks of many sizes and types. Each of these networks is comprised of as many as tens of thousands of computers. In the United States, the National Science Foundation Network (NSFNet) comprises the Internet “backbone” (a very high speed network that connects key regions across the country).

**How are computers connected and how do they communicate on the Internet?** Computers are connected by a variety of media: metal wires, microwave links, radio or fiber optic cables. These connections are usually established within areas or regions by the particular networking organization with authority or economic interest in that area. For example, a university academic department may lay cable to connect its personal computers and workstations into a local area network (LAN), which is then connected to the cables the campus laid to connect its buildings together, which is then linked to cables laid by a regional network, which itself ties into the NSFNet backbone. Hence, the path between any two points on the Internet often traverses physical connections that are administered by a variety of independent authorities. For disparate computers (from personal computers to mainframes) to communicate with other computers over a network, there must be agreements on how that should occur. These agreements are called communication protocols. For a long time the Transmission Control Protocol/Internet Protocol (TCP/IP) suite of protocols defined how Internet computers communicated. However, some non-TCP/IP networks (e.g. BITNET, DECnet) wanted to provide Internet service to their clientele. So, connections called “gateways”, which pass data between networks, were developed to connect non-TCP/IP networks to the Internet.

**How was the Internet created?** The Internet was born about 20 years ago, trying to connect together a U.S. Defense Department network called the ARPAnet and various other radio and satellite networks. The ARPAnet was an experimental network designed to support military research. In the ARPAnet model, communication always occurs between a source and a destination computer using a minimum of information. To send a message on the network, a computer had to put its data in an envelope, called an Internet Protocol (IP) packet, and “address” the packets correctly. The philosophy was that every computer on the network could talk with any other computer. Internet developers began to put their IP software on every conceivable type of computer. It became the only practical method for computers from different manufacturers to communicate. This was attractive to the government and universities, which didn’t have policies saying that all computers must be bought from the same vendor. Everyone

bought whichever computer they liked, and expected the computers to work together over the network. In the late 80’s the National Science Foundation (NSF) created five supercomputer centers. By creating supercomputer centers, the NSF was making these resources available for scholarly research. Only five centers were created because they were so expensive—so they had to be shared. This created a communication problem: they needed a way to connect their centers together and to allow the clients of these centers to access them. At first, the NSF tried to use the ARPAnet for communication, but this strategy failed because of bureaucracy and staffing problems. In response, NSF decided to build its own network, NSFNet, based on the ARPAnet’s IP technology. Regional networks were created in each area of the country wherein schools were network connected to their nearest neighbor. Each chain of networked schools was connected to a supercomputer center at one point and the supercomputer centers were themselves connected together. With this configuration, any computer could eventually communicate with any other by forwarding the conversation through its neighbors. NSFNet computer communication became very popular, and network traffic increased until the computers controlling the network and the lines connecting them were overloaded. In 1987 the NSFNet backbone transmission speed was 56,000 bits per second, and it was upgraded to 1,500,000 in 1989, and to 45,000,000 in 1992. The Internet has grown from 10,000 connected hosts in 1987 to more than 3.2 million host computers and 46,000 interconnected networks as of July, 1994.

**How can I learn more?** Management of NSFNet was relinquished by NSF in April, 1993. NSFNet information services providing help for new and inexperienced users of the Internet is conducted by General Atomics, InterNIC Information Services, San Diego, California. A free subscription to their “NSF Network News” publication can be obtained by sending an email request to info@internic.net, or telephoning 800-444-4345.

# Calendar

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## December

- 12 Sea Grant Proposals due to UNH & UMaine Offices  
contact: Ann Bucklin (603) 749-1565
- 19 NMFS Saltonstall-Kennedy Fisheries Research & Development Grant Proposal deadline  
contact: Joyce Lacerda (508) 281-9256

## January

- 13 RMRP Proposal deadline  
contact: David Townsend (207) 581-1435
- 20 New England Physical Oceanography meeting MIT  
contact: Lew Rothstein  
(lewisr@waupi.gso.uri.edu)

## February

- 6-7 Council on the Marine Environment working group meeting  
St. John, New Brunswick  
contact: Carol Barleon (603) 271-2155
- 17 **RARGOM meeting (snow date is Feb. 24th)**  
**UMass Boston**  
**contact: Genie Braasch (603) 646-3480**

## March

- 16-19 Marine Benthic Ecology Meeting  
Rutgers University, Rutgers, NJ  
contact: Judy Grassle
- tba Council on the Marine Environment special meeting  
Portsmouth area, NH  
contact: Carol Barleon (603) 271-2155

## Gulf Ecosystem Workshop

The 1994 reauthorization of the Marine Mammals Protection Act requires a regional workshop to assess human-caused factors affecting the GoM marine ecosystem. The workshop authority rests with the NMFS laboratory in Woods Hole, and must be convened by April 30 1995. A report to Congress containing scientific findings and proposed regulatory and research actions is due by Dec. 30 1995. Dr. David Dow of NMFS has established an oversight committee, and initiated discussions about RARGOM convening the workshop and overseeing the production of the final report. Contact RARGOM headquarters for more information.

## Gulf of Maine Scientific Symposium

Planning has begun for a major Scientific Symposium focused on the Gulf. Its predecessor was held in Woods Hole, MA during January 1991, whose proceedings\* constitute a major comprehensive scientific benchmark for the Gulf. Since then, several major field programs have been initiated in the Gulf and are beginning to mature. The planned Symposium will facilitate the publication and discussion of recent and ongoing observations and analyses.

The Symposium will be convened by RARGOM in 1996. An initial steering committee has been formed and charged with constituting a permanent committee early in 1995. Contact RARGOM headquarters for details.

\*Wiggin, J. and C.N.K. Mooers, *Proc. of the Gulf of Maine Scientific Workshop*, Urban Harbors Institute, UMass Boston, 1992.

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## Gulf of Maine NEWS

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**We welcome Huntsman Marine Science Centre,  
which joins RARGOM as an Associate member.  
John Allen will serve as the representative.**