Gulf of Maine NEWS

Regional Association for Research on the Gulf of Maine Spring 1995

Contaminated Sediments in Boston Harbor

Eric Adams, MIT

MIT Sea Grant held a one-day symposium on Contaminated Sediments in Boston Harbor on May 8. Participants summarized recent research concerning contaminated sediment sources, their transport and deposition, and their ultimate fate. Additional talks discussed policy implications related to navigational dredging, PAH source control and wastewater treatment facilities.

Wendy Leo from the MWRA discussed contaminant sources and inventories in Boston Harbor, and provided an historical perspective of how these have changed. By far the largest source of contamination has always been sewage-related. The two primary treatment plants built at Nut Island and Deer Island are estimated to discharge about 38 million kg of waste particles to the harbor each year. Until 1991, sludge from these two plants was discharged intermittently to the harbor, contributing another 18 million kg of waste particles.

Within the next couple of years, these two plants will be replaced by a modern secondary treatment facility located on Deer Island, which will include a tunneled outfall extending 9.5 miles into Massachusetts Bay. However, it has not yet been decided how to handle wet weather discharges, including the substantial volume of combined sewer overflow (CSO). Of equal concern is the role that existing sediment contamination—left over from past discharge practices—is playing as a pollution source which will slow down the ultimate recovery of the harbor.

Eric Adams from MIT described field work that he and colleague Keith Stolzenbach (now at UCLA) conducted using fluorescent tracers in Boston's Inner Harbor. One set of studies involved simultaneous releases of two tracers into a CSO at the head of Fort Point Channel, a highly contaminated backwater area of the Inner Harbor. Rhodamine WT dye, designed to track dissolved pollutants, was used to establish hydrodynamic residence times for different conditions of tide and freshwater inflow. A second tracer, fluorescent yellow paint particles, was used to simulate suspended sewage particles. By comparing the disappearance rates of paint and dye, one concludes that upwards of half of sewage particles discharged to the channel—and their associated toxic chemicals—are being trapped in the channel before reaching the Outer Harbor. The inferred rates of deposition are substantially greater than the range calculated for discrete settling or found in laboratory column tests, suggesting that the channel bed may play a critical role in scavenging particles from the water column.

Results from these studies, plus a second tracer study focusing on the residence time of Charles River water in the Inner Harbor, have been used to calibrate mathematical models describing the receiving water impacts of CSOs. These models, in turn, are being used to identify cost-effective CSO control measures for the Boston area.

In a related project, Gordon Wallace and Gene Gallagher from UMass-Boston, Phil Gschwend from MIT and John Farrington from WHOI have been analyzing a series of sediment cores collected throughout the harbor including Fort Point Channel. Their analysis includes sediment characteristics such as porosity, particle size distribution, dissolved oxygen and organic content; the concentrations of trace metals and organics (e.g.,

(continues on page 2)

In This Issue:

(Contaminated Sediments continued)

PAHs and PCBs); infaunal composition; and the activities of radionuclides used to infer rates of sediment deposition and biological mixing (i.e., bioturbation and irrigation). Wallace found sediment deposition rates in Fort Point Channel in the range of 0.4 to 4 cm/yr—significantly greater than those found in the Outer Harbor, and several times larger than rates which could be attributed to known sediment sources in the channel. Similar conclusions pertain to the high metal inventories found in the channel. The high rates of sediment deposition are supported by historical depth changes deduced from bathymetric surveys, and by identification of the fluorescent paint pigments taken from cores collected as part of the previously described tracer study. Together, the data provide strong evidence that at least parts of Boston's Inner Harbor are highly depositional and that most of the contaminated sediments have been imported.

Levels of bioturbation throughout the harbor, inferred from activity levels of Th-234, showed a wide range from about 2*10-7 to 2*10-5 cm2/s. The latter values are extremely high and, if correct, would indicate significant biomixing. However, Gene Gallagher pointed out that they exceed values which can be supported by the numbers of benthic organisms observed at the time of sampling. Gallagher also speculated on how benthic communities might have changed over time, and how they might change once future sources of organic matter are decreased.

Philip Gschwend reported on processes affecting bed-water exchange of hydrophobic organic contaminants. These chemicals are found buried in the sediments mostly sorbed to solid particles which are brought to the interface by biological mixing processes (e.g., bioturbation). Further transport is accomplished either by desorption of the chemical to porewaters which diffuse across the interface, or by particle resuspension followed by desorption in the water column. Using a mathematical model he developed with former graduate student H.-W. Chen and Eric Adams, Gschwend demonstrated that the rate of chemical desorption is not a limiting step in the transport of typical hydrophobic organics. Instead, the greater resistance is due to the boundary layer at the base of the overlying water column. He also demonstrated that colloids (small particles which are transported like fluids, but whose surfaces sorb like solid particles) are not likely to be present in sufficient concentrations to make a significant contribution to bed-water exchange. These findings are important for the modeling of contaminant fluxes within a sediment bed, because they suggest that an assumption of equilibrium sorpotion may be adequate. However, an important caveat attributed to Susan McGroddy, a recent graduate who worked under John Farrington, is that most PAHs are bound to soot particles and not available for equilibrium partitioning.

Marilyn B. ten Brink of the USGS discussed the USGS data base on contaminated sediments in Boston Harbor. Mike Bothner summarized findings from several cores collected in Boston Harbor, saying that silver was a good indicator of sewage particles and that its usefulness in the study of storm-related transport. He also summarized cesium measurements from a core, collected in a depositional area off of Peddocks Island, which suggested a deposition rate of approximately 2 cm/year—consistent with other Pb-210 measurements.

Keith Stolzenbach integrated much of the earlier presentations by addressing the questions of where waste particles ultimately deposit and how long it will take for the flux from existing sediment contamination to drop below acceptable levels. In response to the first question, calculations show that approximately 70% of the contaminated sediments from shoreline sources (rivers, CSOs and stormwater) deposit locally, while less than 10% of effluent solids settle locally. Particles which remain in suspension are dispersed throughout the harbor, with many ultimately being transported to Mass Bay. A mathematical model of tidal circulation, coupled with sediment resuspension, transport and deposition, was developed by graduate student J.J. Lee. The model suggests that only about one-quarter to one-third of all contaminated sediments introduced to the harbor are deposited in the harbor. Furthermore, mass balance studies suggest that approximately 70% of observed deposition within the harbor can be attributed to non-waste particles.

Stolzenbach also addressed the question of how the surficial concentrations of metals and PAHs will decline following cessation of effluent and sludge sources. Using data from Wallace which suggests that most metals, with the exception of lead, are in steady state, he used a mixed layer model of the sediment bed to estimate that surficial sediment concentrations of zinc, copper and lead will decrease exponentially with a time scale of between 13 and 24 years. Burial will be the predominant process reducing metal concentrations, responsible for between 50 and 95% of the predicted concentration decrease.

In contrast to the metals, surficial sediments are now a significant source of PAHs to Boston harbor—depending on the fraction available for transport. Again, burial is the predominant process reducing concentrations of PAH, which will occur over a time span of some 50 years.

Stolzenbach concluded by summarizing outstanding questions left unresolved from these studies. These include: What is the importance of episodic resuspension? What is the influence of estuarine circulation, turbidity currents and wave-induced bedload transport on harbor-wide and local sediment accumulation? What is the nature of non-waste particle input to the harbor? Is there a source of lead that has not been accounted for? Will there be anomalous release of metals from the sediments as a result of increased biological activity?

The technical presentations were followed by brief presentations focusing on the policy implications of this work. Judy Pederson of MIT Sea Grant and Tom Fredette of the Army Corps of Engineers discussed the problems of sediment disposal from upcoming navigational dredging projects, Matt Liebman of EPA used a water quality model to explore the benefits of more aggressive PAH source control and Mike Connor of MWRA talked about remaining issues concerning the area's wastewater treatment facilities.

A monograph should be available this fall. For more information, tel: 617-253-6595, or email: eeadams@mit.edu.

Pinniped Populations in the Gulf of Maine: Status, Issues and Management

Maggie Mooney-Seus &Greg Stone, New England Aquarium

The New England Aquarium conducted a forum on June 14-15 that brought together experts from around the region to discuss what is known about seal populations and to examine the science and policy/management issues resulting from interactions between humans and seals in the Gulf of Maine.

Dr. Jerry Schubel, president of the New England Aquarium, said that his objective in hosting the forum was "to provide a neutral setting for all stakeholders to discuss current controversial topics and identify key factors preventing resolution of these issues". Schubel was particularly enthusiastic about the use of group problem solving computer software that was used to facilitate the final group discussion. The Aquarium hopes that this event will become the first of an ongoing forum series.

The morning session on the first day was used to set the stage for the discussion. Dr. Frank Loew, Dean of the School of Veterinary Medicine, Tufts University, provided remarks about the moral status of animals in America, noting that human attitudes toward animals have changed from a utilitarian value to the view that animals have their own dignity, be it as individuals (i.e. pets) or as species member. Citing Dr. Stephen Kellert's research on this subject, Loew suggested that both facts and values factor into public debate and that it may not be possible to reach consensus, particularly as we enter a global discussion where cultural differences are even more influential. Dr. David Lavigne, University of Guelph, echoed Loew's remarks in his discussion about conflict resolution between seals and fisheries, saying that "scientific advice has had little impact on seal issues, that marine ecosystem models are often overly simplistic, and that information gleaned from bioenergetics and feeding studies has only begun to be integrated with approaches designed to address the role that marine mammals play in marine ecosystems and, specifically, investigation of the potential impacts that they might have on commercial fisheries and vice versa". Lavigne illustrated his talk with a conflict matrix that summarizes where scientific activity can contribute to solutions.

Dr. James Gilbert, University of Maine, gave a status report on seal populations in northern New England. Of the five seal species, (harbor, gray, hooded, harp, and ring), the harbor, along with the gray, are the most abundant and the best understood. Gilbert said that "harbor seals in Maine are a healthy population, that there are lots of them, in good condition". Because Maine is their primary habitat, conflicts with fisheries, aquaculture, lobstering, and recreation are likely to occur. The reasons for the increase in population size are not entirely understood. Increased protection may have created a longer lived female population and/or more accessible safe habitat. The lack of historical record is problematic. Dr. Scott Kraus and Dr. Greg Early, New England Aquarium, also reported increased population growth rates reflected in survey and stranding data in southern New England, but indicated that they are not confident in the accuracy of the trends, given the limited data. It was noted that fishermen have observed more seals way off shore; the speculation was made that the growth rate could be due to immigration from other areas, rather than reproductive rates in the "local populations".

Dr. Joseph Geraci and Dr. Padraig Duignan, University of Guelph, provided an overview of the natural mortality and morbilivirus infection in North American pinnipeds. Harbor seals have a higher disease frequency, while gray seals serve as reservoirs for the virus and are expected to emerge as the dominant species. They noted that many diseases are host population density dependent, and that as seal populations increase, to expect greater outbreaks of disease.

Dr. Gordon Waring, Northeast Science Center, NMFS, described the seal studies that NEFSC has conducted over the past 15 years, noting that research dollars have dwindled, that most of the effort went into cetacean studies (due to public concern in this area), and that there was no future long term research commitment for seals because seal proposals receive low national ranking. The main areas of research effort to date have focused on harbor and gray seal distribution and biology, and marine mammal/fishery interactions.

Daniel Morris, from the NMFS Gloucester office, a member of the Aquaculture ~Pinniped Task Force, reported that his group has met twice in Eastport, Maine, held one public hearing, surveyed growers, visited aquaculture sites, and conducted a literature review. Seal attacks on aquaculture sites occur at night. It is not known whether attacks are made by individuals or groups of seals. Ideas to mitigate the interaction include acoustic devices, predator "scarecrows", and human presence on the site.

Working group discussions were held during the afternoon on three topics: "Ethical Considerations: Balancing Values with Management Choices", "Population Dynamics: What do the Numbers Tell Us?", "Humans and Seals: Relevant Issues for Coexistence". The issues identified during the working group discussions were then ranked by all participants during the final session the following morning, using the group problem solving computer software. Some of the key issues identified were fisheries interactions, the role of seals in ecosystem function, lack of data on seal species distribution and status, aquaculture interactions, and perception of seals by humans. Factors that limit the resolution of these issues were identified as a lack of information (data), a lack of consensus about societal goals and objectives (policy), ambiguity over rules and regulations (goals), and communication. A final matrix was created that ranked the issues with the main factor limiting its resolution. The results will be reported in a document issued by the New England Aquarium later this summer. For a copy contact the Association Office.

Heeding the Bay's Cry: The Fundy Marine Ecosystem Science Project (FMESP)

Peter Wells, Environment Canada, Bedford Institute of Oceanography

The Bay of Fundy is an integral part of the Gulf of Maine. It is an area renowned for its high tides, abundant marine resources, diverse wildlife, long history and outstanding natural beauty. The Bay's dynamic environment is continuously changing, through natural and human activity. Some indicators of marine ecosystem health suggest that ecological changes may be occurring in the Bay, and that parts of the ecosystem are being impaired. Key species (i.e. migratory shorebirds in the Upper Bay, intertidal invertebrates) and habitats (salt marshes, mud flats, shallow subtidal) are at risk.

Such concerns led to a scoping exercise - FMESP. It is being led by Environment Canada (Bedford Institute of Oceanography), the Clean Annapolis River Project (CARP) and the Acadia Centre for Estuarine Research (ACER) and Department of Fisheries and Oceans. The Project's goals focus on four broad questions:

a) What is happening in the Bay of Fundy ecosystem, with special emphasis on the Upper Bay?

b) Is the existing knowledge of the ecosystem sufficient to understand what is happening?

c) What else do we need to know?

d) How are we going to find the answers?

A necessary first activity is to develop a broad base of recent Bay of Fundy information which is presently being compiled from scientific, technical, and anecdotal material. This will form the basis of a discussion paper, describing recent ecological understanding and current issues facing the Bay. A workshop for the scientific community is being organized for September,1995, to discuss the Bay and its issues, and the Project's goals. The aim is to reach a consensus on future research as well as identifying information and coastal management needs for the Bay.

The Newsletter's readers are asked to help us identify sources of recent information (1985 onwards) on the Bay of Fundy's marine ecosystem, its resources and its stresses. Information can include published and unpublished material, photographs and observations of ecosystem or resource changes.
Please send your information to Alison Evans, Project Coordinator, FMESP, ACER, Acadia University, Wolfville, N.S. BOP 1X0. We can be contacted at (fax) 902-542-3466, or (email) aevans@ace.acadiau.ca.

Project Committee: P.G. Wells (DOE/CWS), P. Hicklin (DOE/CWS), J. Percy (CARP), G. Daborn (ACER), M. Brylinsky (ACER), Louise White (DFO), and A. Evans.

The 1995 Spring Bloom in the Gulf of Maine: Report of the R/V Argo Maine Cruises AR-0395 and AR-0495

Michael Sieracki, Maureen Keller, David Phinney, Steve Ackleson, Wendy Bellows, Terry Cucci, Jeff Brown, and Charles Yentsch, Bigelow Laboratory for Ocean Sciences

Two cruises were conducted in the Gulf of Maine as part of the Regional Marine Research Program. The purpose of the cruises was to study the optical properties of various Gulf of Maine water types, spring bloom dynamics, with special reference to Phaeocystis, a potential cause of noxious blooms, and microzooplankton grazing rates in these waters. This report outlines the measurements, samples collected, and experiments conducted, and presents preliminary observations and results we have obtained thus far. Most of our results require considerable sample analysis time back at the lab and so will be forthcoming in published reports. The cruises were blessed with unseasonably calm weather for this latitude and most of our cruise goals were achieved.

Cruises were conducted on the R/V Argo-Maine on 25 March to 1 April and from 8 to 14 April 1995. The cruise plan was to conduct hydrographic (CTD, nutrients, and fluorescence) and optics stations in coastal waters, near Stellwagen Basin, Wilkinson Basin, Jordan Basin, and a line between Wilkinson and Jordan Basins. More intense stations for primary productivity and microzooplankton grazing experiments were held in the three basins.

Optical properties and chlorophyll biomass

The goal was to obtain complete optical data sets consisting of in-water light measurements and laboratory analyses of optically active constituents in Stellwagen, Wilkinson and Jordan basins. In-water measurements included photosynthetically active radiation (PAR), downwelling irradiance (E_d) and upwelling radiance (L_u) at five discrete wavelength bands (410, 441, 488, 520, 560 nm), all measured as a function of depth. A tethered spectral radiometric buoy (TSRB, Satlantic, Inc.) was deployed at each station and monitored incident solar irradiance and upwelling radiance just below the surface at seven discrete wavelengths (406, 412, 443, 490, 520, 565, 665 nm). Samples were collected from the rosette bottle casts at five depths to determine the concentrations of chlorophyll and total suspended solids. Samples were also processed to measure the absorption spectra of total particulates (a_p), dissolved organic material (a_{DOM}) and detritus (a_{det}) from 365 - 750 nm with 1.6 nm resolution. The absorption coefficient for phytoplankton (a_{ph}) can be calculated by $a_p - a_{det}$.

The most significant early results concern the large differences in chlorophyll concentrations between the basins and between the cruises. Chlorophyll decreased in Stellwagen and Jordan Basins over the two week period (from 2 to 1 ug L^{-1}, and 8 to 3 $\mu g\ L^{-1}$, respectively), but increased from 2 to 4 $\mu g\ L^{-1}$ in Wilkinson Basin. The surface reflectance data collected by the

TSRB was compared to the result of a reflectance model using water column chlorophyll values with the resulting correlation coefficient > 0.8. The application of derived absorption coefficients and concentrations of the other optically active constituents will further fine-tune the model results.

Community structure and primary production

Samples were collected and prepared for analysis of microplankton community structure by flow cytometry (unpreserved), inverted microscopy (preserved and stained with Lugols) and epifluorescence microscopy (preserved with glutaraldehyde and stained with DAPI/proflavine). Samples for larger net phytoplankton, microzooplankton, and zooplankton were also collected for numerical dominants. At 2 - 4 different stations within each basin region, primary production rates were measured via P vs. I methodology using a photosynthetron as well as simulated in-situ incubations in 500 ml bottles.

Colonial *Phaeocystis* was not found to be blooming in the regions we sampled. Analysis of samples collected will indicate the abundance the single-cell form. Lower surface phytoplankton biomass and evidence of sinking cells at Stellwagen suggested that the primary spring bloom had ended by late March. The community was diverse and typical of a post-bloom recycling community (see Figure 1). The community at Wilkinson Basin appeared to shift from a recycling system, dominated by pico- and nanoplankton, to a secondary diatom bloom between the two cruises. Large diatoms dominated the community at Jordan Basin during both cruises. The dominant species, however, shifted from *Chaetoceros* to *Rhizosolenia* between the cruises. Results from primary production experiments are presently being compiled. Community structure enumerations and identifications are currently underway.

Microzooplankton grazing

In each of the three major basin stations dilution microzooplankton experiments were conducted to determine phytoplankton growth and microzooplankton grazing rates. Measurements were made of chlorophyll (for total chlorophyll-based growth and herbivory rates) and individual phytoplankton populations distinguishable by flow cytometry. These generally included *Synechococcus*, pico-eukaryotes, cryptophytes, and other cells in the 5 - 20 μm size range (see Figure). Nutrient addition generally enhanced phytoplankton growth indicating nutrient limiting conditions. Linear functional feeding responses were observed for only some cell types at Wilkinson Basin, but on both cruises. A non-linear functional feeding response, indicative of saturated microzooplankton grazing, was observed for total chlorophyll at Wilkinson Basin on the first cruise. Very low or insignificant microzooplankton grazing rates were found at Stellwagen and Jordan basins.

Acknowledgments

We thank Tom Griffith and Deborah Bruce for their assistance at sea, and the captain and crew of the R/V Argo Maine for making this work possible. This work was funded by the NOAA Regional Marine Research Program - Gulf of Maine program

Seafloor Mapping in the Gulf of Maine With Acoustic Imagery

Joseph T. Kelley, Maine Geological Survey

The earliest maps of the seafloor were made by lead soundings coupled with observations of what came back to the ship in some sort of bottom sampler. By the time I worked on my dissertation off southern New Jersey in the late 1970's, it was still possible to use bottom grab samples plotted on existing nautical charts to describe the seafloor.

When I began working in the Gulf of Maine in the early 1980's, it quickly became apparent that existing nautical charts and widely spaced bottom samples were not adequate to understand the complexity of the seafloor. In 1985, the Center for Marine Studies at the University of Maine funded acquisition of a side-scanning sonar device to use in map making. Along with Dan Belknap of the University of Maine, and many graduate students, I began to gather side scan sonar imagery in conjunction with sub-bottom seismic reflection observations, bottom samples and submersible dives to evaluate the seafloor. In the past year, with support from the Regional Marine Research Program, we have compiled more than 10,000 km of geophysical traverses and 2000 bottom samples into an atlas of the nearshore regions of the western Gulf of Maine. Along with provisional bathymetry from NOAA, all of the data is being entered into a Geographic Information System (GIS) and will become available this fall in both paper and digital formats.

The key to our atlas is side-scanning sonar imagery. This instrumentation transmits acoustical energy to either side of a towed device and records the acoustical return. If the bottom is a steep bedrock cliff, the return is strong and records as an almost black image; if the bottom is muddy and sloping away from the towfish, the return appears nearly white. All other bottom types appear in some shade of gray. The practical range of the image is from 25 m to 600 m to either side of a vessel moving up to 10 kts, which permits rapid mapping even in shallow water. The best resolution is around 0.25 m, but objects with distinct shapes, like cables, lobster traps, cracks in rocks or sand ripples are recognizable. Objects which stand up on the sea bottom, like shipwrecks, produce an acoustical shadow which further defines their shape. Software within the device corrects for spacing of objects and imparts a scale on the image.

Despite the advantage side-scanning sonar offers to the mapper, the seafloor of the Gulf of Maine remains extremely variable at all scales. There are two approaches one can take to distributing sonar imagery. One can make available black and white or false-color images which are a direct product of the equipment, or one can interpret the images and produce a map. Because most of the users of our data are likely to have little experience with interpreting acoustical imagery, we have selected to produce maps of the bottom rather than make available original records. Map units, once digitized into a GIS, are also easily wedded to other sorts of information, like grab sample and bathymetric data.

Figure 1 Map Unit Classification Scheme

To map the seafloor we have developed a set of units that reflects the complexity of our region (Figure 1). There are 4 "endmembers", rock, gravel, sand and mud, which are readily recognized in side-scan imagery. In some areas one of these features might dominate a large part of the seafloor, but in most locations a combination of them co-exist. Since a seafloor type must occupy at least 200 m^2 to be mapped at a practical scale, it is necessary to combine units. Thus, map units with rock > gravel, or mud > rock indicate that the dominant feature occupies >50% of the area of the map unit.

Although maps of the sort described are not ideally suited for the needs of many individuals with specific habitat interests, they will permit rapid evaluation of regional differences in the overall nature of the seafloor of the Gulf of Maine. In addition, they will permit individuals with interests in specific habitats many possible areas from which to choose experiment sites. All original data resides in Orono and we hope to make this available upon request for a specific area sometime in the near future.

To contact Joe Kelly, Maine Geological Survey, Geology Dept., Univ. Maine, Orono, ME 04469, tel: 207/581-2162,
e mail: jtkelley@maine.maine.edu

From Cape Cod to the Bay of Fundy
An Environmental Atlas of the Gulf of Maine

Philip Conkling, The Island Institute

A soon-to-be released volume about the Gulf of Maine offers an overview of the region's environmental patterns and commentary about its management challenges. It includes satellite images and aerial photographs along with an interpretive narrative (written for a general audience) contributed by authors from the Gulf of Maine region: John Albright, Spencer Apollonio, Janet Campbell, Philip Conkling, Cynthia Erickson, Janice Harvey, Lloyd Irland, Alice Kelley, Joseph Kelley, Kenneth Mann, Suzanne Meyer, Annette Naegel, David Platt, Richard Podolsky, Harry Thurston, George Woodwell, and Charles Yentsch. It is organized into two parts: Edges of the Sea and Moving Ashore. The following quotes from the book describe its rationale and approach.

Our Backyard from Space

"The authors, photographer, scientists, and computer engineers who contributed to this volume were all given the task of describing, either in word or image, some part of the Gulf of Maine with which they are familiar in ecological terms. Through these views and voices we have tried to integrate many different fields of inquiry. Because this work connects different scales and times, and because it spans natural regions irrespective of borders, we believe it is inherently ecological.

These images and narratives, we hope will serve as simple and comprehensive illustrations of the complex relationships between forests and rivers, and between freshwater rivers and saltwater spawning grounds of such species as lobsters, cod, and haddock. By looking carefully at these images, we can begin to visualize how weather patterns constantly reshape the borders of the southern rim and beaches of the Gulf, or how an unexpected current in the ocean can sweep in over offshore banks and affect fish larval recruitment, or how temperature fluctuations between the eastern and western parts of the Gulf can influence the catch of lobsters. In the past, natural occurrences such as these could be studied at the microscopic level by biologists, but they were imperceptible to most of the rest of us.

Some of the themes of this book are increasingly obvious and have obvious lessons: as sea level inexorably rises along the western edge of the Gulf of Maine shoreline, the costs of trying to hold back the sea will also rise inexorably; if we continue to ignore the subtle but cumulative addition of contaminants in nearshore environments from the effluents of large industrial and municipal outfall pipes, then immensely valuable fish and shell fish habitat will be permanently degraded.

But many other important relationships are not so obvious and await thoughtful observation and careful description. Ninety-five percent of the satellite images this country collected between 1973 and 1993 have never once been seen by human eyes, because expensive mainframe computers and a great deal of technical training were necessary to view them. Now powerful new desktop computers and easy-to-use software mean there is untold opportunity for each of us to gain new insights into ecological relationships in our individual and collective backyards." (pgs. 9-11)

GAIA Software

"In 1988, the Island Institute in Rockland, Maine, initiated a project to develop its own in-house software system to analyze and manage a library of digital images — satellite images and aerial photographs — of Maine's 4,600 islands and associated coastline. The system is designed for a Macintosh desktop computer with color monitor because of its ease of use and affordability. The software is called GAIA, an acronym for geographic access image and analysis. Many of the thematic maps seen it this book were produced using GAIA.

Two years later the Bigelow Laboratory for Ocean Sciences in West Boothbay Harbor, Maine, in cooperation with the Island Institute, initiated a project called Gaia Crossroads to explore the value of satellite images and hands-on image analysis techniques as a tool for teaching environmental sciences at the elementary, middle, and high school levels. Computers donated by Apple Computer were placed in 20 Maine schools. The computers were equipped with satellite images and the GAIA image analysis software. In the years since, we have been overwhelmed by the response of teachers and students, many of whom had never used computers before, and certainly not for a subject that had been restricted to courses taught in graduate departments at a few universities. This approach to teaching environmental sciences has now been expanded to approximately 100 classrooms throughout New England." (pgs. 13-15)

Book Details ~ Special Membership Discount

This volume, edited by Philip Conkling, will be released in July by MIT Press. 272 pp. with 172 illustrations (presently available only in this book format). **Association members wishing to buy copies of this title may do so at a limited special offer of 20% off the list price if ordered before August 31, 1995.** The list price is $29.95 for the paperback edition and the book is available now. Charges for UPS shipping will be extra as will GST charges for all orders mailed to Canada. Orders can beposted to the MIT Press, 55 Hayward St., Cambridge, MA 02142, or called in toll-free, (800) 356-0343. You must provide the identifying promotional code, "GULFX", when you place your order or your discount will not be applied.

Gulf of Maine Ecosystem Dynamics

A Scientific Workshop
September 16-19, 1996
The Algonquin Hotel, St. Andrews, New Brunswick

The steering committee met on June 8th at the Darling Marine Center. The group agreed that the workshop goal is to generate the next set of research priorities and scientific questions for the Gulf of Maine. The workshop is designed to present recent scientific advances from research completed after the Gulf of Maine Scientific Workshop held at Woods Hole in 1991. The working group discussions will be structured to foster cross disciplinary examination of contemporary research concerns. For example, the modeling enterprise as a predictive tool will be discussed in all of the working group sessions.

Each plenary speaker will review the relevant research accomplishments since the 1991 Gulf of Maine Scientific workshop, the role of modeling in the area of focus, and will highlight the key issues as they pertain to offshore and nearshore environments. The following topics are proposed as plenary talks by the steering committee and are listed with the people who are organizing the session and its associated working group. At present, four working groups/organizing teams have been established; it is anticipated that these groups will be further divided to facilitate better discussion and to permit a greater number of topics to be addressed. Two poster sessions also figure into the agenda. By their mid-August meeting, the steering committee expects to complete this stage of the program planning process.

Influence of the Gulf of Maine Circulation on Population Dynamics of nearshore (coastal communities) and offshore (Georges Bank)
organizers: Beardsley, Brown, Lough, Page
Influences of Vertical Transport and Exchange
organizers: Geyer, Incze
Biogeochemical Processes and Contaminant Inputs
organizers: Wallace, Geyer, Mayer, Pederson, Tripp
Human Impacts on Biological Populations - Important Stressors
organizers: Mayer, Gordon, Tripp, Wallace
Recent Advances and Problems in Fisheries Science
organizers: Stevenson, Incze, Lough, Page, Valentine
Ecosystem Modeling Assessment/Overview
organizers: Schlitz, Gordon, Lynch

Steering Committee Members: Gordon Wallace (chair), J. Allen, B. Beardsley, W. Brown, R. Geyer, D. Gordon, L. Incze, G. Lough, L. Mayer, F. Page, J. Pederson, N. Rubinstein, R. Schlitz, D. Stevenson, and B. Tripp. A new group email account for the activities of this committee has been set up. Use this address to distribute comments/ideas to the entire steering committee.
The address is: `rargom2@mac.dartmouth.edu`

Dr. Brian Rothschild named Director of UMAss Dartmouth's Center for Marine Science, Environment and Technology

Dr. Brian Rothschild will assume responsibility for coordinating marine activities at UMass Dartmouth on July 1. Rothschild will oversee the university's marine science/technology, environmental and aquaculture programs and the completion of the new marine science laboratory, located on Clark's Cove in New Bedford.

Rothschild has served as a faculty member at the University of Maryland's Center for Environmental and Estuarine Studies (CEES), Chesapeake Biological Laboratory at Solomons since 1980. Research activity at CEES focuses on oceanographic processes, the ecology of Chesapeake Bay and its watershed, the effects of human activity on the environment, and the ecology of living resources.

Prior to joining the University of Maryland faculty, Rothschild worked at NOAA for nine years as a senior policy advisor and senior scientist. He was responsible for the implementation of the Fisheries Conservation Act of 1976 for NMFS in Seattle, Washington, LaJolla, California and Washington, D.C.

His current research activity includes investigations on the "Theory of Plankton Patch Structure", and "Abundance Estimation and Stock Assessment of the Blue Crab in Chesapeake Bay". Among his past funded research projects were an "Assessment of the Natural and Repletion Populations of Oyster in Chesapeake Bay" and "FISHMAP: A Sampling Expert System for Fish Stock Assessment", and "Fisheries Stock Assessment Collaborative Research Support Program".

Rothschild presently serves as Chairman of the Scientific Steering Committee, GLOBEC International, is secretary of the Scientific Committee on Oceanic Research (SCOR), and is a member of various scientific associations.

Resources

Grants / Sponsored Research

National Oceanic & Atmospheric Administration
Sanctuaries & Reserves Division

The NERRS research priority for FY1996 focuses on habitat restoration. We just received the final draft of the "Announcement of Opportunities for Funding Research in the NERRS for fiscal year 1996". All proposals must address the question: "What are the most appropriate methods, experimental design, models and/or evaluative criteria for restoring estuarine and estuarine-like ecosystems?" Research proposals for one-year projects only will be considered. Pre-proposals must be submitted, postmarked no later than July 14th. Notification about pre-proposals will be issued Sept. 1, final proposals must be postmarked no later than Nov. 1, 1995.

Dr. Dwight Trueblood, Research Coordinator
Office of Ocean and Coastal Resource Management
Attn.: FY96 NERRS Research
1305 East-West Highway, N/ORM2, SSMC4, 12th Floor
Silver Spring, MD 20910
(301) 713-3145 est. 174
Fax: (301) 713-0404
Regional Contacts:
Wells, ME: Dr. Michele Dionne (207) 646-1555
Waquoit Bay, MA: Christine Gault (508) 457-0495
Great Bay, NH: Peter Wellenberger, (603) 868-1095
Narragansett Bay, RI: Al Beck, (401) 683-5061
Financial Data: amount of support per award in recent years: $40,000. to $70,000
matching fund requirements: 30% of total cost of project matched by applicant, federal funds may not be used as part of the match.

U.S. Environmental Protection Agency
The Massachusetts Bays Program

An RFP for "Identification of Massachusetts Bays Embayments at Risk of Eutrophication", has been received. The objective of this project is to estimate nitrogen loading rates to embayments in the Mass. Bays region based on land-use information. The results of the study will be used in the development of consistent methodologies for a state-wide effort to identify nitrogen management areas in coastal Massachusetts. Final proposals are due prior to 12:00 noon, July 12, 1995. The project is expected to commence in August 1995 and conclude in March 1996.

Dr. Diane Gould, Executive Director
Marie Studer, Staff Scientist
Massachusetts Bays Program
100 Cambridge Street, Room 2006
Boston, MA 02202
(617) 727-9530
Fax: (617) 727-2754
Financial Data: amount of support per award: work performed for this project will be provided on a cost-reimbursement basis up to the specified ceiling of $40,000.

National Undersea Research Center

"Research Guidance, Opportunities and Proposal Format Guidelines for 1996 Operations" This publication describes all research program requirements for 1996 proposals. Proposals that are not postmarked by midnight on Sept. 1, 1995 will not be considered for funding during the current solicitation cycle.

Dr. Peter Auster, Marine Program Director
NURP / Univ. of Conn. Avery Point
1084 Shennecossett Road
Groton, CT 06340
(203) 445-4714

Research categories for which marine regional research topics are particularly encouraged include:
the role of landscape on the distribution and abundance of organisms
the effects of anthropogenic impacts on organisms
the impacts of hypoxia on life history, behavior, and trophic-dynamic linkages
the impacts of strategies for ocean disposal
population and community level processes
the energetics, physiology, and growth rates of organisms of particular commercial, recreational or ecological importance
define sedimentary and geochemical processes
the effects of variation in primary production on geochemical cycling and deposition
the role of deglaciation on the sedimentary framework of the northeast U.S. coast

In addition to the topics listed above, the Northeast Fisheries Science Center has identified the following high priority research topics for which information is needed for consideration by regional fisheries management agencies:
the impacts of the developing trawl fishery for sea cucumbers on the benthic habitats in the northern Gulf of Maine
the impacts of hydraulic dredging for surf clams and ocean quahogs on non-target benthic organisms, including siltation effects on growth, mortality, spatfall, and other influences
the impacts of reduced fishing pressure on Georges Bank on the benthos
the effects of trawling on the hard bottom habitats in the Gulf of Maine
the habitat utilization requirements of cod and haddock on Georges Bank during different stages in their life history
the effects of trawling and lobster ports on tilefish and lobster habitat in submarine canyons
patterns of habitat utilization by juvenile fish and shrimp in inshore areas of the Gulf of Maine

Stellwagen Bank National Marine Sanctuary

A research agenda titled "Results of the SBNMS Research Planning Workshop" includes topics which require the use of underwater platforms to obtain samples.
To obtain a copy of this document, contact:
Stellwagen Bank National Marine Sanctuary
14 Union St.
Plymouth, MA 02360
(508) 747-1691
fax: (508) 747-1949

Publications Noted

Reports Received

The following reports have been received at the Association office and are available for distribution by contacting the author.

Auster, P., et al., "Management Implications of Mobile Fishing Gear Alterations to Benthic Habitats in the Gulf of Maine: Science Program Summary", Draft Proposal, May 1995

Carey, G.F., editor, 1995. Finite Element Modeling of Environmental Problems, Surface and Subsurface Flow and Transport. John Wiley & Sons, Chichester, England.

Davis, C., et al., "R/V Endeavor Cruise No. 262 to Georges Bank": *U.S. GLOBEC NW Atlantic Georges Bank Study*, 23 February - 10 March 1995

Durbin, T., et al., "R/V Endeavor Cruise No. 259 to Georges Bank": *U.S. GLOBEC NW Atlantic Georges Bank Study*, 10 - 22 January 1995

Environmental Science in the Coastal Zone: Issues for Further Research, Proceedings of a retreat held at the J. Erik Jonsson Woods Hole Center, Woods Hole, MA, 25-26 June 1992, National Academy Press, Washington, D.C., 168 pp.

Gallager, S., et al., "R/V Endeavor Cruise No. 264 to Georges Bank", 26 March - 8 April 1995

Irish, J., et al., "R/V Iselin Cruise CI9405 to Georges Bank": *U.S. GLOBEC NW Atlantic Georges Bank Study*, 7-10 May, 1994

Irish, J., et al., "R/V Seward Johnson Cruise 9504 to Georges Bank": *U.S. GLOBEC NW Atlantic Georges Bank Study*, 27 March - 4 April 1995

Kenney, R.D. and Wishner, K.F., guest editors, 1995. The South Channel Ocean Productivity Experiment: SCOPEX", C*ontinental Shelf Research*, **15**, No. 4/5:373-611.

Lough, G., et al., "R/V. Seward Johnson Cruise 9503 to Georges Bank": U*.S. GLOBEC NW Atlantic Georges Bank Study*, 14-24 March 1995

Lough, G., et al., "R/V. Seward Johnson Cruise 9505 to Georges Bank": U*.S. GLOBEC NW Atlantic Georges Bank Study*, 7-22 April 1995

Lynch, D.R. and Davies, A.M., editors, 1995. Quantitative Skill Assessment for Coastal Ocean Models, AGU, C*oastal and Estuarine Studies*, **47,** 510 pp.

Miller, C.B., et al., "R/V. Endeavor Cruise 263 Georges Bank Broad-Scale Survey for March 1995": U*.S. GLOBEC NW Atlantic Georges Bank Study*, 13-24 March 1995

Sibunka, J., et al., "R/V Endeavor Cruise No. 265 to Georges Bank": *U.S. GLOBEC NW Atlantic Georges Bank Study*, 11 - 22 , April 1995

Weller, R., et al., "R/V Endeavor Cruise No. 260 to Georges Bank": *U.S. GLOBEC NW Atlantic Georges Bank Study*, 29 January - 6 February, 1995

Wiebe, P., et al., "R/V Albatross IV Cruise 9404 to Georges Bank": *U.S. GLOBEC NW Atlantic Georges Bank Study*, 31 May - 10 June 1994

Wiebe, P., et al., "R/V Endeavor Cruise No. 261 to Georges Bank": *U.S. GLOBEC NW Atlantic Georges Bank Study*, 10 - 20 February 1995

Internet Corner: Authoring for World Wide Web Publication

Jim Waugh, Dartmouth College

The newest Internet service is the World Wide Web (WWW or the Web). The WWW was created from a specification written in 1991 at the European Particle Physics Laboratory in Cern, Switzerland. Electronic publication has growth explosively since then.

WWW "documents" are specially-prepared text files that are retrieved for display using browser programs, so named because they aid in navigation through the Internet. Mosaic and Netscape are the two most popular browser programs.

Web documents are written the "HyperText Markup Language" (HTML), but you don't need to be a computer wizard to write documents for the WWW. HTML documents are text files which contain embedded HTML "tags", or commands, which give structure to a document and suggest (but do not dictate) to Web browser programs the on-screen appearance of the document. HTML directives cause browsers to beautify the embedded text when it is displayed, as well as to empower selected portions of text to function as active "links" or pointers to additional documents and service: e.g. FTP archives and Gopher servers. Links are visually highlighted by underlining. Mouse clicking on an underline causes the browser to traverse to where the link points: it if is a document, it is displayed; if it is a Gopher server, the server's menu is displayed; and so on. Links allow a reader to easily read portions of a document in any order, not just sequentially from beginning to end. HTML files typically have a filename suffix of ".html".

Structural attributes controlled by HTML include not only links, but also the document title, header levels and section names, lists, insert points for graphics, and special emphasis for phrases and keywords. However, HTML cannot control document typeface, point size, screen size, and background, foreground and highlight colors.

Figure 1 shows how this example appears when displayed by the Mosaic browser program.

HTML commands are surrounded by less-than (<) and greater-than (>) brackets. Some tags can appear singly, like (P), which ends a paragraph, and <HR>, which displays a horizontal rule or line the width of the browser window. Other tags occur in pairs, with the trailing member terminating the function started by its preceding mate. Trailing tags have a forward slash (/) prefixed to the tag. As an example, the two tags <H1> and </H1> identify first-level structure within a HTML document.

The following three HTML commands affect the coarsest degree of HTML structure: <HTML> and </HTML> surround the entire document, <HEAD> and </HEAD> enclose just the document's header information, and <BODY> and </BODY> encapsulate the central part of the work. The following document skeleton illustrates how these three tags are nested and relate to each other:

```
<HTML>
    <HEAD>
        Header components go here
    </HEAD>
    <BODY>
        Body components go here
    </BODY>
</HTML>
```

This next example HTML document was constructed using little more than this small subset of HTML commands:

```
<HTML>
    <HEAD>
        <TITLE>A Sample HTML Document</TITLE>
    </HEAD>
    <BODY>
        <H1>RARGOM Web Publishing</H1>
        <HR>
        <H2>Goal</H2>
        Join others in disseminating new concern-
ing     the Gulf of Maine<P>
    </BODY>
</HTML>
```

The most important HTML command pair, the anchor (<A> and </A>), creates a link (or hyperlink) to another document or Internet resource. Links are the WWW mechanism allowing stream of consciousness browsing through Web documents on disparate servers. The anchor tag is so named because the directive fixes, or anchors, the link to a specific resource or location in a document. There are several different types of anchor; however, they all utilize the Web addressing mechanism known as a Universal Resource Locator (URL) to identify where the user may direct the browser program to proceed.

Three varieties of URLs exist, but absolute URLs are the most general because they can reference any resource on the Internet. The syntax for an absolute URL is:

`access-method://server-name [port]/directory/file`

HyperText Transfer Protocol (HTTP) is the access-method used to acquire other Web documents written using HTML. Links can also employ other access-methods, such as FTP, Telnet and Gopher. Server-name and port identify the Internet worked machine and service it provides. The balance of the URL targets a file location on the server machine. Every file on the Internet can be uniquely addressed by a URL.

URLs are embodied in HTML anchor tags using the following syntax:

```
<A HREF="URL">anchor-text</A>
```

Here, HREF identifies the anchor as a hyperlink, URL is the WWW location of the service pointed to, and anchor-text is the passage representing the link in the current HTML document.

Let's create a link utilizing anchors and URLs in our example HTML document. Bruce Tripp at WHOI has created an electronic journal prototype entitled "Coastal Briefs" for publishing short articles on coastal oceanography. The URL for this service is:

http://www.whoi.edu/coastal-briefs/coastal-briefs.html

We can transform the word "others" in Figure1 into a link to this service by changing the "Join others" line to read,

```
Join <A HREF=
"http://www.whoi.edu/coastal-briefs/coastal-
briefs.html">others</A>
```

Figure 2 illustrates the new HTML document's appearance. Notice the underline beneath the word "others", identifying it as a hyperlink to another Web resource. Also notice the URL represented by the link on the Mosaic status line near the bottom of the window; Mosaic always display this information whenever the mouse cursor makes contact with the link. A single mouse click on this link text will cause the Mosaic browser to retrieve and display the "Coastal Briefs" journal. In this manner, an Internet-connected user running a WWW browser program can "Travel" to any Web service or document location in the world.

The WWW and its server and browser programs have substantially reduced the technical difficulty previously associated with electronic information access. While this presentation has been brief due to space limitations, there are many fine books currently available which provide in-depth information regarding authoring with HTML. I recommend "The HTML Sourcebook" by Ian Graham and "HTML Manual of Style" by Larry Aronson.

Calendar

This list includes workshops, meetings, working groups and deadlines for proposals. If you know of upcoming events that might be of interest to the Gulf of Maine research community, please contact us.

July

12	Mass. Bays Program RFP deadline Final Proposals due contact: Diane Gould, (617) 727-9530
14	NERRS Preproposals deadline (see p.9 for contact information)

August

11	Gulf of Maine Ecosystem Dynamics Workshop Steering Committee meeting contact: Genie Braasch, Dartmouth College, (603) 646-3480

September

1	NURC Proposal deadline contact: Peter Auster, NURP, UConn., (203) 445-4714
6-8	Cold Water Aquculture Beyond the Year 2000 Algonquin Hotel, St. Andrews, NB contact: John Allen, Huntsman Marine Science Center, (506) 529-1200
18-20	Ecosystem Health Workshop Dartmouth College, Hanover, NH contact: Genie Braasch, Dartmouth College, (603) 646-3480
21-29	ICES Annual Science Conference Aalborg, DENMARK contact: ICES secretariat, Palaegade 2-4, DK- 1261, Copenhagen, DK, tel: 33 15 70 92

Call for Papers
Cold Water Aquaculture Beyond the Year 2000

September 6-8, 1995
Algonquin Hotel
St. Andrews, New Brunswick

The Huntsman Marine Science Centre will celebrate the opening of the Sir James Dunn Research Laboratory by hosting a conference on the future of Cold Water Aquaculture. The three-day conference will focus on many aspects of aquaculture. The keynote speaker will feature D. Harald Rosenthal from Keil University, Germany/ICES Mariculture Committee, speaking on his vision for the future of aquaculture.

Others who will discuss commercial scale culture of finfish and shellfish, including economics and environmental issues are: Mr. K. Stechey, DFO Canada; Mr. D. MacMinn, NB Fisheries & Aquaculture; and Dr. J. Manzi, Atlantic Seaperfect TLC, USA.

Specific aspects of the culture of finfish, shellfish, other invertebrates and seaweeds, including disease, parasites, nutrition, and technology will be addressed on days two and three. Keynote speakers include: Dr. Grethe Rosenlund, Nutreco, Norway; Mr. James Hall, Production Manager, Promedor Turbot Farms, Spain; Dr. Garth Fletcher, A/F Protein, St. John's, NF; Dr. D.E. Aiken, DFO Canada.

A poster session will be arranged to run all three days.

For more information, contact:
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