

Gulf of Maine NEWS

Regional Association for Research on the Gulf of Maine Summer 1995

Modeling the Gulf of Maine

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Over the past several years, I and several colleagues (see the bibliography) have been busy creating computer models of the Gulf of Maine. The funding and purpose has been multi-faceted, including individual projects with NSF, U.S. GLOBEC, RMRP, and SeaGrant. The basic theme, however, has been constant: to provide a comprehensive 3-D model of the Gulf circulation, and to use it in pursuit of specific, focused scientific investigations with colleagues; and to transfer mature products to operational agencies. Here I will try to provide an overview and progress report, emphasizing first the hydrodynamic circulation, and then the biological application of the computed circulation fields in specific studies.

Circulation Models

We use the finite element method. This involves dividing the ocean into triangular, rather than square, computational elements. Its principal advantage is that it allows variable local resolution, i.e. small triangles where there a lot of detail is needed, and big ones where less is needed. In this way we are able to achieve the wide geographic coverage indicated in Figure 1, including of the entire Gulf, beyond Georges Bank and Browns Banks, and the Scotian Shelf, while maintaining high local resolution (e.g. 1 km on Georges Bank).

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Figure 1: Finite Element mesh.

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(Modeling the Gulf of Maine continued)

There are two families of circulation models: diagnostic and prognostic. The diagnostic family is simpler; it depends on observations for the temperature and salinity, and computes the circulation implied by the observations. Because it has less work to do, it runs fast and we have used it extensively in early and exploratory studies. The prognostic model is more complex. It accounts for tidal-time transport of heat and salt; incorporates advanced turbulence closure, and generally represents the state-of-the-art fusion of finite element technology with the last two decades of research in coastal ocean turbulence closure. Running the prognostic model is our chief occupation today, and the results herein all come from it.

Circulation Model Results

There are three illustrative features of our solutions: the Gulf-wide or “Bigelow” circulation; the Maine coastal current; and Georges Bank.

The Bigelow Circulation: Figure 2 depicts the computed Gulf-wide tidally-averaged circulation, representative of March-April conditions. A dominant feature is the cyclonic gyre (recirculation approx. 0.3 Sv) over Jordan and Georges Basins. This feature has been identified in essentially every circulation study of the Gulf since Bigelow’s seminal 1927 work. Its dynamical origin lies in the dense bottom water present in the deep basins. At depth there are separate gyres over the two basins, which merge near the surface. Figure 2 shows a cyclonic gyre in the “Scopex” region between Cape Cod and Georges Bank, also of baroclinic origin. Unrelated to these is a separate gyre over Grand Manan Basin, which originates in barotropic tidal rectification.

Along the shoreward boundary is a well-developed coastal current. In the eastern Gulf this current is the northern extent of the Jordan Basin gyre described above. It departs from the coast south of Penobscot Bay with only a portion returning to the coast. Further west, additional branch points are found at Cape Ann, where a portion of the coastal current enters and circuits Massachusetts and Cape Cod Bays; and east of Cape Cod, where a portion of the flow (0.1-0.2 Sv) is diverted east to Georges Bank, with the balance exiting the Gulf through Great South Channel. (For a more complete description, see [8].)

Figure 2: Gulfwide stream function (Sv), March-April.

Figure 3: Currents near Cape Ann, 5 m below surface.

The Maine Coastal Current: Several of the above coastal current features have been studied at greater resolution, using a refined mesh of the northern and western Gulf coast. Representative results appear in Figure 3, wherein the branch point at Cape Ann is illustrated under March-April conditions. We are studying the details of this and the other coastal branch points with an emphasis on the transport and fate of contaminants and planktonic species to/from the various estuaries. In Figures 4 and 5 we show representative “numerical drifter” tracks, illustrating the diverse pathways in the Gulf. (See [12] for details.)

Figure 4: Near-coast drifters, 10 m below surface.

Figure 5: Drifters, 60 m below surface.

Georges Bank: To the south of the central Gulf, the familiar partly-closed gyre surrounding Georges Bank dominates the circulation. Such a gyre figures prominently in all studies of the Bank (e.g. [3], [7]). The central Gulf gyre merges with this feature along the northern flank and enhances the along-bank transport there. As part of the U.S. GLOBEC program, we have constructed detailed circulation patterns on and around Georges Bank. In Figure 6 is a representative cross-frontal circulation pattern on a transect across the steep northern flank of the bank.

Figure 6: Georges Bank: cross-frontal velocity structure, northern flank.

The transport of nutrients, zooplankton and fish larvae in the bank's frontal system is a primary concern of this aspect of our modeling (see [11], [14]).

Overall, these features are qualitatively very realistic by comparison with consensus opinion and with contemporary moored and drifting measurements of the circulation. Quantitative comparisons are ongoing. In addition, the model domain has been extended across the Northwest Atlantic shelf, to include the Scotian Shelf in greater detail, plus Cabot Strait and the Newfoundland Shelf ([4], [10], [16]).

Figure 7: Computed distribution of cod larvae.

Coupled Physical / Biological Studies

These circulation fields have been used in a series of studies of cod, haddock, and sea scallops during early-life stages [13]. A principal focus has been on identifying the constraints placed upon these populations by the combination of the physical environment, life cycle, and individual behavior. This research activity is supported by two types of models: Individual-Based and Concentration-Based.

Individual-Based Models: These models follow the trajectories of individual organisms, as they move through the variable environment. The base state of the IBM is the passive particle, which involves only Lagrangian particle-tracking in the computational flow field. To this is added behavioral simulation, including buoyancy and swimming; growth and feeding relationships; and hydrodynamic dispersion via random walk. All of these features are in general sensitive to the current state of the individual (e.g. age, weight); to the ambient fluid state (temperature, salinity, stratification, turbulence); and to the biological environment (e.g. prey concentrations, predation). IBM's have been used on Georges Bank to study the interactions among 3 commercial aggregations of sea scallops [2]; advective influ-

ences on cod and haddock during the egg and larval stages [1, 6]; and the interaction of advection and trophodynamic influences on cod and haddock [5, 9]. A new study is just beginning which will focus on IBM simulation of lobster larvae in the Gulf.

Concentration-Based Models: CBMs are the more conventional description of marine ecosystem dynamics. Concentrations of species are the basic variables. Unlike the IBM, the identity of individuals is lost, so the direct link to biological behavior is not possible. Instead, the coupled interaction among aggregates of several species (e.g. nutrients, phytoplankton, zooplankton) is represented. Generally speaking, we utilize the IBMs for simulating the target species as above; and the CBMs for the lower trophic levels.

At the simplest level, the transport of clouds of passive IBMs is reproduced by a CBM for a conservative substance (Figure 7). Beyond this simple level, the conceptual differences in the two approaches come into play and allow different types of investigations. Creative, hypothesis-focused use of both approaches is necessary, as a generally-accepted canonical description of the biological aspects of marine systems is likely to elude us for some time.

Communications and Collaboration

Collaboration on these studies beyond Dartmouth has been essential. In particular, colleagues at the Bedford Institute of Oceanography; the University of New Hampshire; the NMFS Northeast Fisheries Science Center; St. Andrews Biological Station; the Pacific Biological Station in Nanaimo; and the University of North Carolina. At each of these sites we have installed some modeling capability and are receiving both feedback on model performance and additional software. This community of model users is essential in broadening the participation of the scientific community in the modeling enterprise, and in providing proper scrutiny of our model solutions. Ultimately, we hope to transfer all operational models to operating agencies on both sides of the border, where we hope their evolution can continue.

The internet has been an essential medium of information exchange in this project. All finalized software and circulation results are kept in a public archive which is accessible as a World Wide Web directory (<http://fundy.dartmouth.edu/gom/gom.html>). We are busy now in developing an interactive graphical interface to this data via the combination of web browsers (e.g. Mosaic, Netscape) and graphical tools (e.g. AVS, MatLab). These services will be incorporated into the Gulf of Maine information management system under development within the RMRP. Finally, summaries of recent and ongoing studies using these models are maintained in World Wide Web servers at DFO [16], UNC [17] and Dartmouth [15].

For More Information

A selected project bibliography follows. A complete bibliography and reprints are available upon request. See also the WWW document [15] for a more complete graphical overview.

Selected Bibliography

- 1) Influences of mean advection and simple behavior on the distribution of cod and haddock early life stages on Georges Bank. F.E. Werner, F.H. Page, D.R. Lynch, J.W. Loder, R.G. Lough, R.I. Perry, D.A. Greenberg, and M.M. Sinclair. *Fish. Oceanogr.* **2**:2, 43-64 (1993)
- 2) Drift of sea scallop larvae *Placopecten magellanicus* on Georges Bank: a model study of the roles of mean advection, larval behavior and larval origin. J.M. Tremblay, J.W. Loder, F.E. Werner, C.E. Naimie, F.H. Page, M.M. Sinclair *Topical Studies in Oceanography* (special issue on GLOBEC physical/biological modeling). *Deep Sea Resch II*, **41**, 7-49 (1994).
- 3) Seasonal variation of the 3-D residual circulation on Georges Bank. C.E. Naimie, J.W. Loder, D.R. Lynch. *J. Geophys. Resch.* **99**, C8, pp. 15,967-989 (1994).
- 4) Seasonal variation of the baroclinic circulation in the Scotia-Maine region, C.G. Hannah and J.W. Loder. *Proc. 7th Int. Biennial Conf. of the Physics of Estuaries and Coastal Seas*, Woods Hole, MA, 28-30 November 1994.
- 5) A Coupled Individual-Based Trophodynamics and Circulation Model for Studies of Larval Cod and Haddock on Georges Bank, F.E. Werner, R.I. Perry, R.G. Lough, D.R. Lynch. *U.S. GLOBEC News*, Sept. 1994. (<http://www.usglobec.berkeley.edu/usglobec/news/news7/news7.cisco.text.html>)
- 6) Influence of wind-driven advection on interannual variability in cod egg and larval distributions on Georges Bank: 1982 vs. 1985. R.G. Lough, W.G. Smith, F.E. Werner, J.W. Loder, F.H. Page, C.G. Hannah, C.E. Naimie, R.I. Perry, M.M. Sinclair, D.R. Lynch. *ICES mar. Sci. Symp.* **198**: 356-378 (1994).
- 7) Convergence studies of tidally rectified circulation on Georges Bank. D.R. Lynch, J.T.C. Ip, C.E. Naimie, F.E. Werner. *Quantitative Skill Assessment for Coastal Ocean Models*, D.R. Lynch and A.M. Davies, American Geophysical Union, Coastal and Estuarine Studies Volume 47, 1995.
- 8) Comprehensive coastal circulation model with application to the Gulf of Maine. D.R. Lynch, J.T.C. Ip, C.E. Naimie, F.E. Werner. *Continental Shelf Research*, in press 1995a.
- 9) Trophodynamic and advective influences on Georges Bank cod and haddock, F.E. Werner, R.I. Perry, R.G. Lough, C.E. Naimie. *Deep Sea Research II, Topical Studies in Oceanography*, Special Volume on Georges Bank (in press 1995). (See also <http://www.marine.unc.edu/OPNML/manuscripts/mans.html>)
- 10) Hydrography and Baroclinic Circulation in the Scotian Shelf Region: Winter vs. Summer. J.W. Loder, G. Han, C.G. Hannah, D.A. Greenberg and P.C. Smith. *Canadian Journal of Fisheries and Aquatic Sciences Supplement*. Submitted, 1995.
- 11) Georges Bank Residual Circulation during weak and strong stratification periods - Prognostic numerical model results, C.E. Naimie. *J. Geophys. Resch.* (in press 1995).
- 12) Dynamical Influences on the Maine Coastal Current. D.R. Lynch, M.J. Holboke, C.E. Naimie. *Continental Shelf Research* (submitted 1995b). (An early version is at http://fundy.dartmouth.edu/nml/mcc_html/mcc2.html)
- 13) Cod Fishery Collapses and North Atlantic GLOBEC, M. Sinclair and F. Page, *U.S. GLOBEC News*, March 1995. (<http://www.usglobec.berkeley.edu/usglobec/news/news8/news8.sinclair.html>)
- 14) USGLOBEC Progress Report: Importance of physical and biological processes to population Regulation of Cod and Haddock on Georges Bank: a Model-Based Study. D.R. Lynch et al., <http://fundy.dartmouth.edu/gom/progress95/report.html> (1995).
- 15) Numerical Methods Laboratory — Environmental Program. <http://fundy.dartmouth.edu/nml/environmental.nml> (1995).
- 16) Northwest Atlantic Shelf Hydrodynamics, C.G. Hannah et al. <http://biome.bio.dfo.ca/~channah/nas1.html> (1995).
- 17) Ocean Processes Numerical Modeling Laboratory, F.E. Werner et al. <http://www.marine.unc.edu/OPNML> (1995).

Sources, Transport, & Nutrient Environment of Toxic “Red Tide” Populations in the Western Gulf of Maine

Donald M. Anderson¹, Brad Butman², Derek Fong¹, Peter J.S. Franks³, W. Rockwell Geyer¹, Bruce A. Keafer¹, Theodore C. Loder III⁴, and Richard P. Signell²

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²United States Geological Survey

³Scripps Institution of Oceanography

⁴University of New Hampshire

Franks and Anderson (1992) found that the coastal current in the western Gulf of Maine has a strong influence on the distribution and fate of a toxic dinoflagellate, *Alexandrium tamarense*. They posed the “plume advection hypothesis”, which states that a source population of *A. tamarense* near the mouth of the Kennebec-Androscoggin Rivers is advected long distances along the coast by the freshwater plume of the rivers flowing into the western Gulf of Maine. In order to test this hypothesis and thus

to better understand the coupling between dinoflagellate distributions and physical transport processes, a team of investigators performed a combined field and modeling study of the physics and *Alexandrium* distribution in the western Gulf of Maine Coastal Current. This study has been supported by the Regional Marine Research Program since 1993.

Measurements of the physics and biology were conducted during two intensive sampling periods in the spring of 1993 and 1994. The measurements included a total of 14 shipboard surveys on the R/V ARGO Maine, the R/V Anderson, and the R/V Jerry Chase, as well as deployment of current meter moorings and surface drifters, and satellite observations of sea-surface temperature.

The pattern of river discharge was similar between 1993 and 1994, and the wind conditions were generally similar (figures 1 and 2). However there were several strong, downwelling-favorable (northerly to northeasterly) wind events during the period of peak river discharge in 1993, while in 1994 the winds were upwelling-favorable (southerly to southeasterly) during the

Figure 1. 1993 Observations in the western Gulf of Maine. Time series of winds measured at the meteorological buoy and freshwater inflow from the Kennebec/Androscoggin river system are shown. Positive wind stresses correspond to upwelling favorable conditions while negative winds correspond to downwelling favorable conditions. The timing of hydrographic surveys off of Cape Porpoise are indicated by the dotted lines. The observed plume width during the surveys are indicated in km with a subjective interpretation of the winds preceeding each survey; D indicates downwelling favorable winds prior to the survey while upwelling favorable winds are labelled with a U. (from: Fong et al., 1995)

critical period of peak river discharge. This seemingly minor difference in wind-forcing produced markedly different plume conditions and correspondingly large differences in the number and distribution of *Alexandrium* cells. In 1993, the plume generally hugged the coast, and virtually all of the fresh water coming out of the western Gulf of Maine rivers could be observed within the southward flowing coastal current, which extended continuously along the coast into Massachusetts Bay. In 1994, there were episodes of southward transport, but they were interrupted by several upwelling events that caused the plume to spread offshore and actually to head northeastward for several days to a week. Much of the fresh water was transported offshore, and the salinity of the coastal waters were considerably higher than in the spring of 1993, even though the freshwater input was the same.

These differences in hydrographic conditions were reflected in marked differences in the *Alexandrium* sp. distributions. During 1993, the plume carried *Alexandrium* cells southward, consistent with the plume advection hypothesis, and a number of

coastal stations reported toxicity as the cells contaminated the coastal monitoring stations. During 1994, the upwelling conditions resulted in offshore transport of the early background concentrations of *Alexandrium* sp., preventing the development of a sufficient population to cause nearshore shellfish toxicity. Later, several shellfish sites near Casco Bay also became toxic, but these outbreaks did not persist due to the strong upwelling conditions. In 1994, no toxicity was detected in Massachusetts Bay, suggesting that the persistent upwelling prevented the low-level populations to the north of Cape Ann from seeding the southern waters via advection.

One implication of these observations is that not only the seasonally averaged forcing conditions, but also the timing of these forcing variables, is critical in determining the transport processes and their influence on populations. The subtle connections between run-off, wind-forcing and toxic plankton distribution emphasizes the need for time-dependent models that can actually account for the covariance between the critical forcing variables and ultimately predict the occurrence of red tides.

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Figure 2. 1994 Observations in the western Gulf of Maine. Time series of winds measured at the meteorological buoy and freshwater inflow from the Kennebec/Androscoggin river system are shown. Positive wind stresses correspond to upwelling favorable conditions while negative winds correspond to downwelling favorable conditions. The timing of hydrographic surveys off of Cape Porpoise are indicated by the dotted lines. The observed plume width during the surveys are indicated in km with a subjective interpretation of the winds preceding each survey; D indicates downwelling favorable winds prior to the survey while upwelling favorable winds are labelled with a U. Winds between cruises 6a and 6b are relatively neutral and labelled with a questionmark. (from: Fong et al., 1995)

("Red Tide" continued)

Several "levels" of modeling are being pursued in this project to understand and ultimately to predict the variations of the physical regime and the associated red tide population. A simple, two-dimensional model was developed to examine the time-variations of offshore extent of the plume (Fong and Geyer, 1994; Fong et al., 1995). This analysis indicates that wind forcing is indeed the principal agent responsible for variations in the width of the plume, but that the basic Ekman dynamics are significantly modified by time-dependence and friction between the plume and the underlying water.

A more computationally-intensive, 3-dimensional model is also being implemented. This is the same model that was used by Signell and co-workers (e.g., Signell et al., 1993) to simulate the flow in Massachusetts Bay. The western Gulf of Maine domain extends from Penobscot Bay to Cape Cod and out to the 100 m isobath. One of the difficulties of implementing a "limited domain" model such as this is the specification of the open boundary condition. We are using the output of a larger scale model of the entire Gulf (Namie et al., 1994) to "drive" the open boundary. Another critical issue is the parameterization of vertical mixing, which is accomplished by a second-order turbulence closure scheme (Mellor and Yamada, 1982). The idealized, two-dimensional model indicated that friction was important, implying turbulence in the stratified shear layer at the base of the plume. The comparison between the 3-D model and observations show discrepancies that may be explained by an underestimate of the friction term. This study of the turbulence parameterization of the model is important both for the predictive skill of this model and for the general problem of mixing in river plumes.

In addition to these physics-oriented model studies, we are also modeling the coupled physics-biology problem (Figure 3). So far, our simulations have addressed the advection and growth of cells, with a simple, temperature-dependent growth function. These runs have shown that nature is more complicated than the model. One of the difficulties is adequately parameterizing the source function, which we believe to originate from a "seed population" of cysts in the bottom sedi-

Figure 3. Modeled Salinity and Alexandrium concentration during early April when downwelling-favorable wind conditions keep the salinity and Alexandrium plumes trapped near the coast. In this simulation, Alexandrium cells were discharged continuously, only in the Androscoggin/Kennebec river system at a concentration of 100 cells/liter. As seen in the field data, the cell concentrations essentially track the Androscoggin/Kennebec river plume. The cell concentrations are relatively low due to cold spring water temperatures.

ments near the mouth of the Kennebec River. Other questions involve the role of physical aggregation at fronts (Franks, 1992), the influence of nutrients on growth, and predation. Ultimately, this coupled modeling effort will lead to a better understanding of the dynamics of the Alexandrium population as well as a potential predictive tool for forecasting "red tide" outbreaks.

References

- Fong, D.A., Geyer, W.R., and R.P. Signell, Ekman dynamics of the western Gulf of Maine plume. *J. of Marine Systems*, 1995, submitted.
- Fong, D.A., and W.R. Geyer, Wind-forcing of river plumes. AGU Fall Meeting, San Francisco, CA. Abstract: *EOS Supplement*, 1994, **75**: 052-7.
- Franks, P.J.S., Sink or swim: accumulation of biomass at fronts. *Marine Ecology Progress Series*, 1992, **82**:1-12.
- Franks, P.J.S. and D.M. Anderson, Alongshore transport of a toxic phytoplankton bloom in a buoyancy current: *Alexandrium tamarense* in the Gulf of Maine. *Marine Biology*, 1992, **112**:153-164.
- Mellor, G.L. and T. Yamada, Development of a Turbulence Closure Model for Geophysical Fluid Problems, *Rev. of Geophys. Space Physics*, 1982, **20**: 851-875.
- Naimie, C.E., Loder, J.W., and D.R. Lynch, Seasonal-Variation of the 3-Dimensional Residual Circulation on Georges Bank, *J. of Geophysical Research-Oceans*, 1994, **99** (8): 15967-15989.
- Signell, R.P., Jenter, H.L., and A.F. Blumberg, Modeling the Seasonal Circulation in Massachusetts Bay, *Proceedings of the 3rd International Conference on Estuarine and Coastal Modeling III*, Publ. by ASCE, NY, 1994, pp. 578-590.

Resources

Grants / Sponsored Research

National Science Foundation

Directorate for Geosciences, Div. of Ocean Sciences

Dr. Phillip Taylor

(703) 306-1587

Deadline: 15 January 1996

National Oceanic and Atmospheric Administration

Coastal Ocean Program and National Marine Fisheries Service

Mike Dowgiallo

(301) 713-3338

The U.S. Global Ocean Ecosystems Dynamics Program

Northwest Atlantic Field Studies, Phase 2

Announcement of Opportunity (excerpted sections below)

The Division of Ocean Sciences of NSF, and the Coastal Ocean Program and National Marine Fisheries Service of NOAA announce an opportunity for ecosystem dynamics studies in the Northwest Atlantic on Georges Bank and surrounding regions as part of the U.S. Global Ocean Ecosystems Dynamics (U.S. GLOBEC) research program. This announcement solicits proposals for field observation and process studies commencing in 1997, for modeling investigations, and for retrospective data analysis, as described below and in planning documents of the U.S. GLOBEC program. This is the second in a sequence of announcements for U.S. GLOBEC studies in the Northwest Atlantic, a program which began in 1993.

This opportunity is open to all interested, qualified and eligible researchers irrespective of whether they have been previously involved in the U.S. GLOBEC, NW Atlantic/Georges Bank program. NSF and NOAA encourage the submission of multiple/competitive proposals for the components of the Phase 2 program of research. To facilitate access by all prospective investigators to the information derived from Phase One, the U.S. GLOBEC Program Managers have asked that all presently funded PIs make available a summary of the status of their present work and findings. Summaries of the objectives, methods, and key findings (to date) of the currently funded projects are available on the U.S. GLOBEC Georges Bank Program's World-Wide Web homepage:

<http://globec.whoi.edu>

and on the U.S. GLOBEC homepage:

<http://www.usglobec.berkeley.edu/usglobec/globec.homepage.html>

Also available on the Georges Bank homepage is the text of several cruise reports from Phase I. For the complete text of this announcement, or if you are unable to access any of this information, either call or send an e-mail message to:

Mr. Bob Groman (508-289-2409; groman@whoi.edu) or

Dr. Phil Taylor (703-306-1587; prtaylor@nsf.gov).

For reasons of program planning and development, investigators intending to submit proposals in response to this announcement are requested to send a brief (1-2 page) statement of scope to:

Dr. Thomas Powell

Chair, U.S. GLOBEC Scientific Steering Committee

Dept. of Integrative Biology, Univ. of California, Berkeley, CA 94720

(510)643-0877; fax: 510-643-1142; Internet: zackp@violet.berkeley.edu

Natural Sciences & Engineering Research Council of Canada

International Fellowships Office

350 Albert Street

Ottawa, Canada K1A 1H5

(613) 995-1818

Fax: (613) 992-5337

Deadline: Nov. 15

Visiting Fellowships in Canadian Government Laboratories

National Science Foundation

Directorate For Biological Sciences

Division of Biological Instrumentation and Resources

Dr. Carter Kimsey

(703) 306-1469

Deadline: Nov. 3

Postdoctoral Research Fellowships in Biosciences Related to the Environment

This new fellowship program provides an opportunity to gain additional scientific training beyond the doctoral degree and to pursue innovative and imaginative research into the fundamental mechanisms underlying the interactions between organisms and their environment at the molecular, cellular, organismal, population, community and/or ecosystem level in any area of biology supported by the Directorate for Biological Sciences. See NSF 94-114.

Division of Biological Instrumentation and Resources

Dr. John Porter

(703) 306-1469

Target Date: Nov. 1

Scientific Databases for the Biological Sciences

This program provides support for cross-disciplinary efforts to design, develop, implement, and use database resources. Research collaboration among biologists and computer scientists and information retrieval specialists from both academic and commercial organizations is strongly encouraged. To facilitate access to current information technology, support is provided for planning, designing, prototyping, implementing, and distributing biological databases, algorithms, and software relevant to analysis of biological information, and of new methods and software supporting construction, operation, and access to biological databases. The use of techniques to enhance information accessibility, retrieval, & sharing via the network, and other innovative uses of the network, in support of a national biological information infrastructure. See NSF 90-70

Dr. John Porter

(703) 306-1469

Deadline: None

Computational Biology Activities in the Biological Sciences

This program promotes, supports, and facilitates the development and use of computational tools, algorithms, community software, and related research that will enhance biological sciences research and infrastructure. See NSF 92-62.

Division of Environmental Biology

Dr. Michael Allen, Program Director

(703) 306-1483

Fax: (703) 306-0367

Deadlines: Nov. 13, May 13

Biotic Surveys and 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, &/or other documents in electronic and printed form. See NSF 94-66.

U.S. GLOBEC Georges Bank Program to hold Scientific Investigators' Workshop

Bob Groman, Woods Hole Oceanographic Institution

The Scientific Investigators' Workshop for the U.S. GLOBEC Georges Bank Program will take place in Woods Hole, Massachusetts, Monday, October 16, 1995 through Wednesday, October 18, 1995. Each Scientific Investigator will have an opportunity to present their recent results and findings within the context of several major themes, including Bank-wide Structures, Stratification and Its Effects, and Population Dynamics of Target Species. We will also take this opportunity to see what other data are needed to synthesize our results. The 1996 cruises will also be discussed during this workshop.

The agenda outline will be distributed to Scientific Investigators via electronic mail. If you have any questions or would like further information contact Chip Clancy (mclancy@whoi.edu/508-289-2321) or Bob Groman (rgroman@whoi.edu/508-289-

Bridging the Gulf: A Watershed of Watersheds

A U.S./Canadian citizen's conference on Environmental Monitoring in the Gulf of Maine

May 31-June 1, 1996

Holiday Inn By The Bay, Portland, Maine

The Collaboration of Community Foundations is organizing a conference about how local efforts in the U.S. and Canada contribute to the overall health of the Gulf of Maine ecosystem, and how community-based efforts can be enhanced through networking, sharing experiences and increasing skills and capacity. Through water quality monitoring, coastal cleanups, education, outreach and other local activities, citizen volunteers and local community groups are active stewards of natural resources and effective leaders in their communities. This is an opportunity for the research community to share its activity and results with others who are concerned and active in the region. Speakers for this event are sought. The next planning meeting is October 30. Contact Lissa Widoff (617) 723-7415 or lwidoff@igc.apc.org for more information.

Conference Themes:

State of the Gulf - Overview of GOM ecosystem, citizen monitoring, and environmental trends in the Gulf

organizers: Lissa Widoff, Graham Daborn, Steve Hawboldt

Bridging the Gulf - Linking Citizens, Science and Policy.

organizers: Steve Hawboldt, Karen Pelto, Graham Daborn, Lissa Widoff

Local Knowledge/Collective Action - Case Studies of Local Coastal and Watershed Efforts

organizers: Kathleen Esperanza, Susan Eddy

Testing the Waters

organizers: Henrietta List, Joe Payne, Jeff Schloss, Geoff

Dates, Allison Lowe

Internet Corner: Harvesting Internet Information with "Gopher"

Jim Waugh, Dartmouth College

The Internet, a network of networks, is enormously big, and searching within this "cyberspace" for information can be a daunting task. The Internet has been accurately described as a library with all the volumes dumped on the floor. However, there is a program that brings order to this chaos, and that utility is "Gopher".

Gopher was created at the University of Minnesota, and it can be run using a very simple command set on an alphanumeric terminal. Gopher actually consists of two programs: a server and a client. A Gopher server organizes information hierarchically, and a Gopher client retrieves this data across a network and presents it to the user in nested lists of menu items, much like many graphics programs organize their pop-up or pull-down menus into successive levels of submenus. Gopher menu items can point to files, directories, other Gopher servers, FTP archives, and more.

The name "Gopher" is derived from "gofer", a low-level employee who retrieves things for the boss, and also the pesky rodent that burrows a path traversing landscaped lawns, gardens and fields. Similarly, the Gopher client program tunnels around the Internet for the purpose of retrieving information to the computer user. Gophers exist for virtually all popular computer platforms, and the software can be obtained from either the University of Minnesota or commercial vendors.

To run Gopher on a Unix machine, enter the command name followed optionally by the server host, e.g.

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gopher gopher.who.edu
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(If you do not identify which server to access, most Gopher clients are configured to establish a default connection to the University of Minnesota gopher server.) In this example after connecting to the Woods Hole Oceanographic Institution server, the display on the client's CRT screen is illustrated in figure 1.

Helpful commands are always shown at the bottom of the screen as an aid to gopher novices. The gopher pointer can be moved up and down the menu list by using the keyboard up/down arrow keys. If a keyboard lacks these keypads, the "k" and "j" keys can frequently be substituted. Menu items terminated by a forward slash "/" character indicate lower level menus, which can be retrieved by positioning the gopher pointer to the desired line and pressing the ENTER, RETURN or right-arrow keys. A menu item can be directly selected by keying-in the item number followed by the ENTER or RETURN key. When in a low-level menu, control reverts one level up by pressing the "u" key. For paging through verbose presentations which exceed the screen size, the SPACEBAR or PageDown keys scroll the browser forward, while the "b" or PageUp keys scroll the display backwards.

Keyword string searches can be performed on the currently displayed material by pressing the forward slash "/" key; a text "window" obliterates part of the display prompting the user for the target string, as shown in figure 2.

When searching inside a document, Gopher highlights the display of all occurrences of the sought-after verbiage. When searching in a menu, Gopher repositions its pointer to the first occurrence of the target item; thereafter, repeatedly pressing the "n" key searches forward to the next instance. If a keyword search of menus across Gopher space is needed, the "Veronica" utility (Very Easy Rodent-Oriented Net-wide Index to Computerized Archives) can be utilized to retrieve Gopher items whose titles match the search target. In this case the user gophers to gopher.tc.umn.edu and selects the menu "Other Gopher

and Information Servers". The result of the Veronica search is presented as a Gopher menu whose line items point to the desired resources.

Among other handy Gopher features is a "bookmark" capability that allows a user to customize subsequent Gopher sessions. After traveling a complex path to a menu item, that item can be assigned a name by pressing the "a" key. That name, or bookmark, can later be employed to return directly to the chosen site by pressing the "v" key to view the bookmark list. Also, additional information about a menu item can be obtained without actually selecting it by positioning the Gopher pointer at the item and pressing the equals "=" key; this is an especially convenient and time saving feature where, after a Veronica search, menu items can be Gopher resources on servers anywhere in the world.

Gopher client and server software can be acquired from the University of Minnesota using anonymous FTP access to the /pub/gopher directory on the machine boombox.micro.umn.edu. Government agencies and educational institutions may use Gopher without licensing charges. Businesses must pay a modest fee for Gopher to help defray its development costs. Gopher's ease of use, its intrinsic help features and ability to automatically "do the right thing" have resulted in a dearth of how-to user reference material. However, installing and managing a Gopher server is a challenging project usually assigned to computer specialists. This latter group of people will benefit from "Managing INTERNET Information Services", published by O'Reilly & Associates, which is a book containing several chapters of valuable Gopher configuration information.

Calendar

October

- 11 Deadline for abstracts for AGU/ASLO meeting special session (see announcement to the right)
contact: David Mountain, NMFS
dmountai@whsun1.wh.shoi.edu
- 16-18 U.S. GLOBEC NW Atlantic Program
Scientific Investigators meeting
Woods Hole, Massachusetts
contact: Bob Groman, (508) 457-2000 x.2409
- 23-25 Regional Marine Research Program
Principal Investigators and Board meeting
University of Maine, Orono
contact: David Townsend, (207) 581-1435
- 30 CCF Bridging the Gulf conference planning meeting (see description, p.10)
contact: Lissa Widoff (617) 723-7415

November

- 10 **RARGOM meeting**
University of New Hampshire
contact: Genie Braasch, Dartmouth College,
(603) 646-3480

December

- 11-15 American Geophysical Union Fall meeting
San Francisco, CA
contact: Steven Bell, AGU meeting office
(202) 462-6900 ext. 238

January 1996

- 15 Deadline for U.S. GLOBEC NW Atlantic program phase 2 proposals (see announcement, p. 9)
contact: Dr. Phillip Taylor, Div. Ocean Sciences, NSF (703) 306-1587 or Mike Dowgiallo, NOAA Coastal Ocean Program (301) 713-3338

Call for Abstracts

“Physical / Biological Interactions on Georges Bank and the Gulf of Maine”

The ASLO/AGU meeting on February 12-16, 1996 in San Diego, CA will have a special session on “Physical/Biological Interactions on Georges Bank and the Gulf of Maine”. This is an opportunity for investigators in the GLOBEC NW Atlantic program, the Regional Marine Research Program and other studies to share results with colleagues. The strength of these programs is their broad, interdisciplinary nature - and the results from each project are important to all others. Hopefully there will be two oral sessions and a poster session.

Abstracts are due to AGU or ASLO by October 11.

For information on submitting an abstract, see the August 22, 1995 issue of EOS. Or, you can request information/submit an abstract by electronic mail to: os-request@earth.agu.org. Additionally, the AGU home page on the World Wide Web contains all meeting information: <http://www.agu.org>. Kristen Hansen, AGU office, 202-462-6900 ext. 382 will also provide assistance. The co-conveners of this session are: Peter Wiebe (WHOI, pweibe@whoi.edu) and David Mountain (NMFS, dmountai@whsun1.wh.who.edu).

RARGOM Home Page Now Available <http://fundy.dartmouth.edu/rargom/>

A world wide web home page has been set up and contains the following categories of information:

- Overview of the RARGOM
- Membership Information
- Collaboration with other organizations
- Articles of Association
- Member and Associate Member Institutions Home Page links
- Representatives to the Association
- RARGOM Documents and Publications
- Some Gulf of Maine Research Projects
- Sea Surface Temperature Data
- Further Related Gulf of Maine Information

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Gulf of Maine NEWS

Summer 1995
Volume 3 Number 3
Issued four times a year
Editor: Eugenia F. Braasch