

New England Estuarine Research Society

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Fall 1994 Meeting
October 20-22, 1994
Old Jailhouse Tavern
Orleans, Massachusetts

MEETING

ABSTRACTS

Baillie, Priscilla W., Marine and Freshwater Research Service, 276
State Street, Guilford, CT 06437
SALT POND CREATION AS MITIGATION FOR IMPACTS ON TIDAL WETLANDS

As mitigation for filling a wetland, a salt pond was created replacing a dense stand of Phragmites. The 0.7 ac subtidal pond was hydrologically connected to a tidal marsh. Oxygen, pH and salinity did not vary much between the pond and marsh. Anaerobic industrial effluent discharging into the wetland exhibited extremely high pH, conductivity and nitrogen. During storms, pH, NO₃/NO₂-N and NH₄-N rose in the pond on the flood tide, but returned to near background levels on the ebb. Total phosphorus increased on the early flood but was exported on the ebb. Crustaceans and fish invaded the pond but molluscs were absent. Despite the industrialized environment, the sheltered permanent open water offered a variety of habitats for wildlife.

**Boucher, Joceline, Corning School of Ocean Studies, Maine
Maritime Academy, Castine, ME 04420
CAREER RELATED ASPECTS OF UNDERGRADUATE MARINE SCIENCE
PROGRAMS**

The purpose of undergraduate marine science programs has frequently been debated, most often in relation to the adequate preparation of students for graduate school. However, the career goals of many students do not, at least initially, include graduate work. The Corning School of Ocean Studies recognizes the diverse needs of its students and has integrated some career-related training into its undergraduate program. This poster addresses some of the ways the Corning School has found to provide job training as well as to meet the needs of students who seek post-graduate education.

Boxhill, Jessica L., Lorry Santiago Vazquez, Timothy R; Harrison
Kenneth Forman, and James N. Kremer, Boston University Marine
Program, Marine Biological Laboratory, Woods Hole, M.A. 02543
DAILY VARIATION IN PHYTOPLANKTON PRODUCTION IN TWO SUBESTUARIES
OF WAQUOIT BAY, MASSACHUSETTS

Jessica Boxhill will be presenting her research, conducted in the summer of 1994, on primary phytoplankton production in two estuaries subject to different rates of nutrient loading. While previous studies have documented seasonal variation in phytoplankton production, this study examined variation on a daily basis. The rates of phytoplankton production in the two estuaries will be compared, and the variation in two physical parameters: incident light and water temperature will be discussed. Finally, a comparison will be drawn between the daily production rates, and the average monthly data (June-July) for both estuaries over the period of 1990-1993.

Buchsbaum, Robert and Andrea Cooper. Massachusetts Audubon Society, Wenham, MA 01984
TRANSFERRING SCIENTIFIC INFORMATION TO MANAGERS ON THE LOCAL LEVEL: THE PLUM
ISLAND SOUND MINIBAY PROJECT

Plum Island Sound is a 13,000 acre estuary in northeastern Massachusetts well known for its productive clam flats and migratory bird populations. In 1992, the Massachusetts Audubon Society was funded by the Massachusetts Bays Program to develop a model conservation initiative in this small embayment. One of the main goals of the Minibay Project is to identify major sources of pollution and to present this information to town officials along with suggestions about how to address the problems. Research to date has focused on quantifying the bacterial concentrations at various sampling stations in both wet and dry weather, determining the bacterial loading rates from different tributaries, and calculating the flushing characteristics of different parts of the Sound. Land use research has included a shoreline survey for potential sources of pollution and a build out analysis.

Results of our research have been presented at meetings to officials and citizens groups of the three towns. Responses have varied from wholesale acceptance to intense cynicism. We believe that the diversity of responses is not due to an unsuccessful transfer of information, since explaining fecal coliform contamination is straightforward at our current level of understanding of the Sound. Rather, the success of the project depends on the political climate within each community and our own ability to maintain good relations with the towns.

Burdick, David, Jackson Estuarine Laboratory, UNH, Durham, NH 03824, Michele Dionne, Wells National Estuarine Research Reserve, Wells, ME 04090, and Dan McHugh, Great Meadow Farms, Rowley, MA 01969
INITIAL RESPONSES TO TIDAL EXCHANGE RESTORATION IN TWO SALT MARSHES

New Hampshire has lost ca. 50% of marsh area due to direct anthropogenic impacts, and much of the remaining acreage continues to deteriorate due to structures that reduce tidal flow. Resource managers at state and federal levels have recognized the widespread and rapid loss of marsh functions, and have sponsored marsh restoration projects. At two restoration sites, salt marsh responses were assessed through measurements of hydrology, soils, and plants. Dredge spoil was removed from a marsh invaded by *Phragmites australis* at Rye Harbor. After one year, the area had become better drained: soils were more oxidized and pore water more saline. Mean height of *Phragmites* stems fell substantially, indicating a reduction in plant vigor. Where pools had drained, *Scirpus* spp. was replaced by *Salicornia* spp. and *Spartina* spp. At Stuart Farm, a tide gate under a roadway was replaced with an arched culvert to reestablish tidal flooding after 30 years in a meadow invaded by *Lythrum salicaria*. Flooding frequency of the 4 ha meadow was greater than that of the salt marsh downstream of the culvert, possibly from subsidence. Water table and salinity increased rapidly in the meadow, resulting in the death of *Lythrum* within a year.

Burdick, David, and Frederick Short, Jackson Estuarine Laboratory, and Department of Natural Resources, University of New Hampshire, Durham, NH 03824
THE EFFECTS OF DOCKS ON EELGRASS IN MASSACHUSETTS COASTAL WATERS

The direct impacts of docks on eelgrass beds were investigated in Waquoit Bay, Nantucket Harbor and Woods Hole, Massachusetts. We measured dimensions and structural characteristics of docks associated with eelgrass beds, physical characteristics of the sites (water depth and light penetration), and eelgrass population characteristics (shoot density, canopy height, and growth rate). Shading was found to be the predominant impact of docks on eelgrass. Of 21 sites where docks ran through eelgrass beds, only five had substantial eelgrass populations growing under the dock. Compared to reference beds, eelgrass shoot density was low under and adjacent to docks. Canopy height under docks was similar to reference beds, but was shorter adjacent to docks, perhaps due to boat damage. Height of a dock above the water, and secondarily orientation of a dock, were found to be the most important characteristics for determining eelgrass bed quality under docks. Our study shows that docks can be designed with the necessary height and orientation to provide enough light under docks to allow eelgrass beds to thrive.

Burn, P.B., Moore, R.H., Rosol, M., Davey, E., and Perez, K.
Suffolk University, Massachusetts General Hospital, and U.S.E.P.A.

E.R.L. / Narragansett

NOT SHOTS PART DEUX: AS CLEAR AS MUD

Benthic studies have traditionally been hampered by the difficulty of extracting and counting benthic macrofauna, and of quantifying dynamic processes such as bioturbation. We have used Computerized Tomography (CT) scanning to view 6 inch diameter mud sediment cores from Narragansett Bay, RI. CT allows for non-invasive examination of 1.5 mm thick core sections with resolution of structures to 1 mm. The digitized data have been reformatted for alternate planes of view, 3-D reconstructions, or to examine specific windows of X-ray absorbance. We have identified organisms from 2 dimensional images of their shells, as well as characteristic tubes and burrows. The x-ray absorbance window corresponding to water can be isolated and imaged in 3 dimensions as a "burrowgraph". Powdered tungsten was applied to the surface of sediment cores as a tracer of bioturbation in microcosm experiments. The center of gravity of the tracer moved down significantly from the mud/water interface after 30 days at summer temperatures. Bioturbation as measured by tungsten movement was reduced in communities dominated by permanent tube builders, and at lower temperatures.

Joseph E. Costa, Buzzards Bay Project, Marion, MA 02738

NITROGEN TMAL'S FOR BUZZARDS BAY EMBAYMENTS

The Buzzards Bay Project developed a strategy to manage anthropogenic nitrogen sources to protect and restore water quality and living resources in Buzzards Bay. The strategy focuses on implementation of land use and sewage management controls which are based on annual nitrogen mass loads estimated from land use evaluations. The mass loading approach (as opposed to a water quality standard) was deemed the most defensible management strategy based on existing scientific knowledge, and was also the strategy most likely to be successfully implemented. In the recommended approach, Total Maximum Annual Loads (TMAL's) for nitrogen impacted embayments are established based on historical trends in water quality and estimates of historic inputs of nitrogen based on land use. For unimpacted embayments, or impacted areas where historical data are lacking, a tiered system of TMAL limits was established that could be applied to any embayment of known size and hydraulic flushing. This tiered system was based on the best available scientific information from experimental and ecosystem response documented. Since it is meaningful to characterize nitrogen loading rates as either annual loadings per unit area or volume during the water turnover time, both methods were used to establish nitrogen loading limits. Turnover time, using a "Vollenweider model" flushing coefficient like that used for setting phosphorus limits to lakes, is used to establish the nitrogen loading limits. Recommended nitrogen TMAL limits are tiered to reflect existing water quality management classifications as well as bathymetric and hydrographic features of the embayment.

Eichner, Eduard M. and Charles G. Lawrence, Cape Cod Commission, 3225 Main St.,
Barnstable, MA 02630

NITROGEN IMPACTS FROM LAND USE IN COASTAL EMBAYMENT WATERSHEDS: USING NITROGEN LOADING TO DEVELOP MANAGEMENT OPTIONS

The Cape Cod Commission is implementing provisions of the water resources classification strategy contained in the Regional Policy Plan for the effective management of water quality within coastal embayment watersheds. The classification strategy provides the framework for setting standards based on the assessment of water quality needs of water bodies and developing effective implementation methods to meet the standards. The effort for an individual embayment involves a four step process: 1) delineating the embayment's watershed, 2) conducting of a flushing study of the embayment and calculating the water quality standard(s), 3) quantifying the nitrogen loads from existing development and future potential development, and 4) comparing the nitrogen loads to the water quality standards and developing management options. The status of the Cape Cod Coastal Non-Point Source Management Project will be discussed and results from several Cape Cod embayments will be presented.

Farrington, John W., Woods Hole Oceanographic Institution, Woods Hole, MA 02543.
UNDERGRADUATE MARINE SCIENCE MAJORS - SOME CAUTIONS.

Increased interest in education that focuses on various aspects of environmental sciences and environmental issues is welcome because human civilizations face serious environmental challenges. There is an increased interest in under-graduate education in marine sciences because of the critical role of the oceans in many of the environmental issues. Concurrently, budgetary pressures at several colleges and universities have called into question the role and teaching load of predominantly graduate faculty in ocean sciences. One response is to offer more undergraduate courses in a variety of topics in marine sciences, and also minor and major courses of study. I submit that properly planned and executed minor or major courses of study in marine sciences and appropriate if it is clearly understood by students, faculty, and potential employers what these courses of study entail, and the types of careers for which students are prepared. Do we have such an understanding?

Findlay, Stuart; Robert Sinsabaugh² and David Fischer. Institute of Ecosystem Studies, Millbrook, NY 12545 and ²Dept. of Biology, University of Toledo, Toledo OH 43606.
DISSOLVED ORGANIC CARBON SOURCES FOR PLANKTONIC BACTERIA IN THE HUDSON RIVER ESTUARY.

Bacterial production in the water column of the Hudson greatly exceeds phytoplankton productivity so we have been examining various sources of allochthonous DOC as bacterial growth substrates. DOC from tributary inputs, wetlands and porewaters was 0.2 A-filtered and inoculated with raw Hudson water as a bioassay approach to determining suitability as a carbon source. Concurrently, we assayed a suite of extracellular enzymes to assess which carbon pools were being degraded. DOC exported from wetlands supported higher rates of bacterial production than water from the mainstem. Enzymatic activities varied among source waters indicating differential contributions of DOC pools.

Fogarty, Katherine, Charles Menzie, and Jonathan Freshman, Menzie-Cura & Associates, 1 Courthouse Lane, Chelmsford, MA 01824.
BIOACCUMULATION OF CONTAMINANTS IN DEPLOYED AND NATIVE BIVALVE SHELLFISH OF THE THAMES RIVER ESTUARY, CONNECTICUT

As part of a study of contaminant sources to the Thames River estuary, we assessed potential bioaccumulation of chemical contaminants in bivalve shellfish by measuring contaminant levels in ribbed mussels deployed in cages in the estuary for one month. We also measured contaminant levels in native oysters, hardshell clams, and blue mussels from the same areas. As part of the same study, we collected surface water and sediment samples for chemical analysis. Our work compares contaminant concentrations in these media and in the organisms and compares our results to similar studies.

Franz, David R. & Tom Choina, Brooklyn College CUNY, Brooklyn, NY 11210
COMMUNITY-STRUCTURE OF INTERTIDAL SANDFLAT INVERTEBRATES IN JAMAICA BAY,
NEW YORK - AN URBAN ESTUARY

Lower intertidal invertebrates were sampled in 1992 and 1993 in two Bay regions. In addition to acquiring baseline data on invertebrates, we hoped to answer the following: (1) Is sand-flat community structure in the eastern bay (poor circulation; maximal distance from mouth) different from the western bay? (2) Does community structure vary with shore level? (3) Do point sources of chemical pollutants (leachate PCBs, PAHs) affect community structure? An array of community matrix methods (diversity indices, rarefaction, cluster analysis, PCA etc.) were used. Differences in species composition and diversity between regions and shore levels were detected, although pollution may modify expected vertical patterns. We hypothesize that that stress due to vertical shore position is additive with pollution stress. Consequently, at contaminated sites, greatest depression of diversity occurs at higher shore levels.

Gardner, G. Bernard¹, Tracy Villareal¹, Theodore Loder², Susan Hegarty¹, Chantal Lefebvre¹, Zehra Schneider¹, and Samantha Woods¹: Environmental Sciences Program, University of Massachusetts/Boston, 100 Morrissey Blvd., Boston, MA 02125; ²EOS, Orse Hall, University of New Hampshire, Durham, NH 03824
AN INTERDISCIPLINARY STUDY OF PHYTOPLANKTON AND NUTRIENT DYNAMICS IN CAPE COD BAY: PROJECT DESCRIPTION AND EARLY RESULTS

Previous observations (Geyer *et al.*, 1992) of hydrographic, nutrient and phytoplankton concentrations in Massachusetts and Cape Cod bays indicated a significant distinction between the two regions, with Cape Cod Bay displaying an earlier winter/spring bloom than regions to the north. Nutrient and hydrographic regimes were also dissimilar. We initiated a new research program in the fall of 1993, with funding from the Massachusetts Bays Program and the Massachusetts Water Resources Authority, designed to clarify the complex interactions of physical, biological and chemical processes responsible for the early initiation of the bloom. A total of six cruises have been conducted to date in the Bay on which hydrographic, biological and nutrient data were obtained. An overview of the project will be presented with a sampling of data acquired to date.

Geyer, W.R., G.B. Gardner, W.S. Brown, J. Irish, B. Butman, T. Loder, R.P. Signell, 1992. *Physical Oceanographic investigation of Massachusetts and Cape Cod Bays*, Massachusetts Bays Program, **MBP-92-03**, 497 pp.

Geist, Margaret, Waquoit Bay National Estuarine Research Reserve, Waquoit, MA 02536
Citizen Activism at Waquoit Bay, Massachusetts.

The history of the Waquoit Bay National Estuarine Research Reserve is a chronicle of citizen activism that continues to this day. It is a narrative of people working together to preserve an ecosystem at risk, a way of life, a landscape of great beauty. Their successes include the preservation of South Cape Beach and Washburn Island, on whose barrier beaches Piping Plovers and Least Terns nest, and parts of the Quashnet River, where trout and herring once again travel to their spawning grounds.

Citizen efforts led to the designation of the Reserve in 1988 but did not stop there. On-going activities include active citizen participation in water quality monitoring, bird and plant surveys, and support for outreach programs at the Reserve. Endeavors of a citizens' action committee resulted in the declaration of Waquoit Bay as a Federal No-Discharge Zone as well as calls to action on issues such as nitrogen and phosphorus loading and protection of critical habitats.

Hegarty, Susan G., and Villareal, Tracy A., Environmental Sciences Program, University of Massachusetts/Boston, Boston, MA 02125

SEASONAL VARIATION IN SURFACE WATERS OFF FALLON PIER (JFK LIBRARY, BOSTON HARBOR)

Surface water samples were collected on a weekly basis off the Fallon Pier (JFK Library) from August 1993 to September 1994. Samples were analyzed for nutrients (phosphate, nitrate and nitrite, ammonium, and silicate), size-fractionated chlorophyll a (total and < 10 μm), dominant species and temperature. In general, nutrient concentrations varied over the annual cycle in a manner consistent with seasonal patterns of biological production. Nutrient concentrations were lowest in late September/early October 1993. This period corresponded with the occurrence of a fall bloom of *Asterionellopsis*. Nutrients increased through the late fall to a maximum in early December. The late fall/winter period, from November 1993 to February 1994, was characterized by low chlorophyll a, with primary producers consisting mainly of nanoplankton (<10 μm fraction). Cell counts were dominated by events in August-September 1993, June-July 1994 and September 1994. The late summer period of 1993 was marked by blooms of *Prorocentrum*, *Skeletonema* and *Asterionellopsis* species. Sporadic blooms of *Cryptomonas* and *Skeletonema* occurred during the mid-summer period, followed by a reappearance of *Prorocentrum* in significant numbers.

Hickox, Sara, University of Rhode Island, Graduate School of Oceanography, Narragansett, RI, 02882-11970

LIVING ON THE EDGE: A COASTAL EXHIBITION AND EDUCATION PROGRAM

URI's Office of Marine Programs has received a \$663,000 NSF grant to create a unique exhibition and education program designed to offer an understanding of coastal ocean science and its social implications to broad audiences and present opportunities for exposing youth to exciting new scientific frontiers through interactive educational exhibits. Living on the Edge will focus on an array of traditional tools and new technologies that are being used to enhance practical understanding of the coastal ocean. The eight interactive exhibit units, totaling approximately 1,500 square feet, are to be produced in triplicate. One set will be on permanent display at URI's Narragansett Bay Campus, one will become the cornerstone of a broader environmental exhibit at the Museum of Science in Boston, and a third will tour a dozen science museums and nature centers throughout the country through the Association of Science-Technology Centers' traveling exhibition service. Former URI/GSO dean and NOAA administrator Dr. John Knauss serves as senior science advisor on the 30-month, multi-disciplinary project. The project's principal investigator will discuss the role that scientific and educational advisors from the academic community can play in providing advice and feedback for the content and topics to be covered in the exhibits and associated educational programs.

Jaworski, Norbert A., U.S. Environmental Protection Agency, Environmental Research Center, 27 Tarzwell Drive, Narragansett, RI 02882, and Robert W. Howarth, Room E 311, Section of Ecology and Systematics, Cornell University, Ithaca, NY 14853.

COMPARISON of the NUTRIENT and METAL LOADINGS for the NEW ENGLAND COASTAL WATERS and for the SEVEN MAJOR ESTUARIES, PART II.

At the Spring meeting, the authors had estimated nutrient and metal loadings from point and non-point sources for the seven major estuaries and the New England coastal waters.

A comparison of the surface area loadings (normalized in terms of kilograms/ Km^2/yr) was presented for organic carbon, phosphorus, nitrogen, and five heavy metals. In this presentation, the focus will be on the sources of the nutrients and metals. Management implications will also be featured.

Cadet Kevin J. Kemey¹, Dr. Steven R. Long², LT Michael R. Hicks¹. ¹ U.S. Coast Guard Academy, New London, CT 06320, ² NASA Observational Science Branch, Wallops Island, VA 23337
MEASUREMENTS OF THE INTERACTIONS OF WAVE GROUPS OF DIFFERING WAVELENGTHS

Rogue waves are those that form from the interactions of other waves and are much larger, steeper, and more energetic than the average wave which currently exists *on* the water's surface at the time of the rogue wave's formation. Interactions of waves which form devastating rogue waves in the open ocean are poorly understood. To better understand such waves six tests of wave interactions were carried out *in a* modern wave tank located at the Air-Sea Interaction Research Facility of NASA's Observational Science Branch. Three tests were performed without the influence of a current and three were performed with waves propagating against a current of approximately 10 cm/sec. In each test, an envelope of waves was created at a high frequency and short wavelength, and was followed by an envelope of waves created at a lower frequency and longer wavelength. The long waves overtook the short waves at a predetermined location in the tank to analyze the interaction. The basic form of data taken was wave elevation as determined by capacitance wires located throughout the wave tank. Each test was performed 100 times to obtain an ensemble average. Preliminary review of the data using the Hilbert transform time series analysis indicates that it is possible to create rogue waves in an experimental setting and better define the characteristics and causes of rogue waves.

Krahforst, C. F., and G. T. Wallace. Environmental Sciences Program, University of Massachusetts, Boston, MA 02125

The distribution of silver in waters of Boston Harbor and Massachusetts Bay

Dissolved and particulate silver concentrations were determined in samples collected in August 1994. Samples were collected along a transect from Boston Harbor to western boundary of the Gulf of Maine transecting Massachusetts Bay and Stellwagen Bank. Dissolved silver concentrations ranged from 122 pMol kg⁻¹ at the Boston Harbor entrance to values between 2.2 - 4.9 pMol kg⁻¹ in Stellwagen Basin and Gulf of Maine surface waters. Particulate Ag (0.4 µm filter - retained) ranged from 484 pMol kg⁻¹ at the Boston Harbor entrance to around 3 pMol kg⁻¹ in the surface waters of Stellwagen Basin. Water column distributions of silver and other selected metals (Cu, Zn, Pb, Cd), will be used to define sources and processes controlling transport of metals to Massachusetts and Cape Cod Bays.

Lefebvre, Chantal M., George B. Gardner, Tracy A. Villareal, Department of Environmental Science, University of Massachusetts, Boston, Massachusetts, 02125-3393.

THE ENVIRONMENTAL SIGNIFICANCE OF GROUNDWATER AS A SOURCE OF NUTRIENTS INTO COASTAL CAPE COD BAY.

Salinity profiles of Cape Cod Bay (CCB) indicate a marked inflow of freshwater along the coastal regions of the Bay. Since the hydrology of the Cape is largely dominated by groundwater with apparent high concentrations of nitrogen, then groundwater seepage into the coastal zone may be responsible for the observed low salinity signal. Moreover, this freshwater may be altering the ambient nutrient ratios in CCB which, in turn, could affect the proliferation of certain phytoplankton assemblages. In particular, an influx of nitrogen from groundwater may be increasing the nitrogen-to-silicate ratio sufficiently enough to alter the growth pattern of diatoms. Data will be presented to characterize the nutrient and physical dynamics of southeastern CCB, and consequences of such nutrient loading will be discussed.

Monaghan¹, Eileen, and Anne Giblin², 'University of Massachusetts at Amherst, Amherst MA, 01003 and ²MBL, Woods Hole, MA, 02543
THE FLUX OF NUTRIENTS FROM OXIC AND ANOXIC SEDIMENTS

The purpose of this experiment was to determine the importance of coupling between the oxic and anoxic portions of sediments and to examine the extent to which this coupling influences the ultimate flux of nutrients to the overlying water. The oxic (top 2 cm) and anoxic (the next 10 cm) portions of sediment cores were separated and incubated separately. The flux of nutrients to the overlying water was monitored. The oxic portion of the sediment was incubated with oxic overlying water and the anoxic portion was incubated with anoxic overlying water. Intact cores were incubated with oxic overlying water as a control. Anoxic portions of the sediment released more ammonium and phosphate than either the oxic portions of the sediment or the controls. The controls released slightly more total dissolved inorganic nitrogen (ammonium + nitrate) than the anoxic portions but less than the sum of the oxic and anoxic layers. Denitrification of nitrogen and adsorption of phosphate by iron are two mechanisms which may reduce nutrient release when the layers are coupled.

Orson, Richard A., Wetlands Division, Najarian Assoc., Inc., Eatontown, NJ 07724, 'R. Scott Warren and William A. Niering, Botany Dept., Connecticut College, New London, CT 06320

THE STABILITY AND APPLICATION OF 137Cs IN DATING TIDAL MARSH PEATS

Although 137Cs has been used by many investigators to date estuarine sediments, relatively little is known about its behaviour after deposition. Since analysis of 137Cs is a function of concentration, any vertical translocation of the isotope could render its results useless for dating purposes. The Barn Island marsh provides a unique opportunity to determine the stability of 137Cs in marsh peats for it contains physical horizon markers bracketing the 1963 peak in aboveground thermonuclear testing. Comparisons of cesium concentrations to horizon markers shows that 137Cs is stable in these peats and can be used to accurately define the 1954 and 1963 horizons. Limited cesium mobility means that we can rely on this marker to identify time lines, carefully track sea level changes and model surface accretionary processes.

Pearce, John, Northeast Fisheries Science Center, NOAA, Woods Hole, MA 02543
TRANSLATING SCIENCE INTO MANAGEMENT -- HOW, WHEN, AND HOW MUCH?

During the past half decade concern for the application of science to management has grown exponentially. Organizations such as the Estuarine Research Federation have expressed interests in improving "the process." Financial limitations make it ever more important that management is based on the best data, and accomplishes its goals. Using science in management requires: 1) asking the right questions, 2) setting criteria and standards, 3) using the political processes, and 4) ensuring that effective education and communication are in place to garner requisite support. Finally, 5) accomplishments must be clear and measurable. Ocean disposal and management of ground fishes are used as case studies and specific steps discussed.

Pellegrino, Peter E., South. Conn. State Univ. Bio. Dept. New Haven, CT
LONG ISLAND SOUND ALIVE

Long Island Sound Alive (LISA) is an interactive multimedia guide to the invertebrates of Long Island Sound. LISA is a hypermedia laser disk production that incorporates live video footage of invertebrate organisms along with their natural habitats. LISA will allow students to view living invertebrate animals with their natural colors rather than just looking at preserved specimens in jars.

LISA will allow students to relate invertebrate communities to habitat characteristics thereby obtaining a truly functional view of the ecosystem. Students will be able to select a habitat of taxonomic approach to the study of estuarine invertebrate life.

I have taped over 450 living invertebrate species. The projected completion date for Long Island Sound Alive is Fall 1995.

Pond, Robert, B., Exec. Director, Stripers Unlimited, Inc., P.O.Box 3045, So. Attleboro, MA 02703

ON THE FACT THAT FISHERIES MANAGEMENT POLICY DOES NOT ADDRESS THE BASIC CAUSES OF FISH STOCK DECLINE.

Review of "Feeling for the Organism" by Evelyn Fox Keller on Dr. Barbara McClintock's research on mobil genetic elements and research to the subject by Dr. A. Crosby Longwell of the NMFS. This research suggests that mobil genetic elements are affecting egg quality in marine fish. Slides of striped bass eggs and intestines that indicate major health problems exist in this species (*Morone saxatilis*). Most fisheries management policies are based on overfishing and habitat loss. As a temporary solution this may work, but it does not address the basic causes of fish stock decline.

Portnoy, John, National Biological Survey, Cape Cod National Seashore, South Wellfleet, MA 02663
BIOGEOCHEMISTRY AND RESTORATION OF AN ALTERED CAPE COD ESTUARY,
HERRING RIVER WELLFLEET

The Herring River, diked since 1908, provides a good example of the effects of tidal restrictions on wetland vegetation, elemental cycling, water quality and dependent fauna. The diking, coupled in the 1930's with ditch drainage and creek channelization, has resulted in acid sulfate soil formation, episodic stream acidification and anoxia, and a depauperate aquatic fauna. Field and laboratory experiments are being conducted to examine the biogeochemical effects of the salinity and water level changes associated both with the original diking and with current efforts toward the restoration of tidal flow.

Potts, Mary-Susan, Biology Dept., Northeastern University, Boston, MA 02115.

EFFECTS OF HEMATOPOIETIC NEOPLASIA ON REPRODUCTION AND POPULATION SIZE DISTRIBUTION IN THE SOFT-SHELL CLAM

The soft-shell clam, *Mya arenaria*, is susceptible to Hematopoietic neoplasia (Hn), a disease in which atypical cells invade the clam's circulatory, digestive, reproductive and excretory systems. In this study disease effects on the morphology of the clam's reproductive organs were examined. In addition Hn prevalence was evaluated with respect to sex and as a function of size in the total population and in a cohort of clams. Methods utilized included field sampling, routine histology and computer image analysis. Disease effects on the gonads were increasingly apparent as abnormal cells filled the clam's connective tissue. As Hn advanced, the gonadal follicles became significantly smaller in size but were not reduced in number. While Hn prevalence was unrelated to the sex of the clam, the data supported a relationship between Hn prevalence and size. Clams 40-70mm had the highest prevalence of Hn, and a cohort of clams showed increasing Hn prevalence as they grew into this disease susceptible size range. In general the data suggest that Hn reduces the reproductive capabilities of diseased individuals and may directly alter the size distribution of soft-shell clam populations by removing particular size classes through mortality.

Pregnall, Marshall, Department of Biology, Vassar College, Poughkeepsie, NY 12601
MUDFLAT AEROBICS AND OTHER EXERCISES IN AN ESTUARINE ECOLOGY COURSE

In a summer course on Estuarine Ecology taught on the Coos Bay, Oregon estuary, I have students explore the diversity of estuarine habitats, sampling techniques, and observational versus experimental approaches to study via structured field and laboratory projects. The duration of the course (eight weeks, two full days each week) permits us to gather extensive data sets in the field and laboratory and to revisit habitats previously sampled in order to pursue questions of interest that have arisen from initial observations and measurements. I will present examples of class data sets from projects intended to introduce students to (1) the spatial and temporal variability of physical, chemical, and biological parameters in the estuarine water column, and (2) the concepts of sampling sufficiency vs insufficiency and data display for analyzing salt marsh plant and mudflat macroinfaunal communities, as well as examples of results from several student-designed and executed research projects.

**Roman^s, C.T., J.W. Portnoy², and J.R. Allen.³ National Biological Survey, ¹University of RI, ²Cape Cod National Seashore, and ³North Atlantic Field Station, Boston, MA.
SCIENCE AND RESOURCE MANAGEMENT: EXAMPLES FROM NAUSET MARSH (CAPE COD NATIONAL SEASHORE)**

For several decades the National Park Service and local towns (Orleans, Eastham) have sponsored studies of the Nauset Marsh back-barrier estuary in an effort to better understand the functioning of the system with the goal of developing science-based resource protection strategies. Research programs have focused on salt marsh habitat ecology, marsh development and sedimentation processes, nutrient fluxes and groundwater discharge, and barrier spit geomorphology and ecology. These data serve as a baseline in interpreting the response of the estuary to inlet migration, sea level rise, and catastrophic events (e.g., contaminant spills). Moreover, non-point source nutrient loading and water quality monitoring are being addressed with the expectation that management strategies can be adopted to avoid future estuarine eutrophication problems.

Charles T. Roman and John W. Portnoy, National Biological Survey, University of Rhode Island, Narragansett, RI 02882, Charles L. LaBash and Peter V. August, Environmental Data Center, Department of Natural Resources Science, University of Rhode Island
SALT MARSH RESTORATION AT HATCHES HARBOR, PROVINCETOWN, MA

Hatches Harbor is a tidal salt marsh estuary located 0.5 miles south of Race Point in Provincetown, MA. The tidal system is partially restricted by a dike that was constructed in 1930 for mosquito control. An airport constructed in the mid-1930s has benefited from the flood protection provided by the dike. Tidal restriction has lowered salinity and has reduced water volume in the obstructed portion of the system causing changes in vegetation composition of the marsh. A system that was historically dominated by salt-tolerant *Spartina patens* and *S. alterniflora* has been replaced by common reed (*Phragmites australis*) and shrubs associated with low-salinity and freshwater wetland systems. During the 1980's interest in understanding the dynamics of the marsh showed that partially restoring tidal flow to the system would improve circulation, increase oxygen levels, restore fish populations, and restore the vegetation of the system. Marsh vegetation was photointerpreted and elevation profiles were surveyed and entered into a Geographic Information System (GIS). This poster shows how GIS was used to examine the relationship between marsh surface elevation and vegetation and how vegetation composition changes as a function of distance to the tidal channels in the system. These analyses will assist in predicting where changes in marsh vegetation will occur as tidal flow to the restricted portion of the system is increased.

"NURC's Aquanaut Program: Understanding Research and Science Through Marine Science"

P.M. Scheifele and D. Tedeschi

Science often eludes the average citizen. The decline of the number of students seeking advanced education in the hard sciences begins in the middle school grades and is cemented in the secondary school grade levels. The Aquanaut Program has been developed to rekindle interest in science, familiarize students and teachers with the modern scientist, teach scientific methodologies, and promote environmental stewardship by involving students and teachers in a hands-on approach to field research. The program utilizes advanced technologies for conducting in-situ underwater research including occupied submersibles, remotely operated vehicles, and sonar suites. The Aquanaut Program will be described and its impacts on undergraduate education discussed. Impacts to secondary school students and teachers will be presented by Mr. Tedeschi, a high school teacher who has participated in the program for the past five years.

**Schneider, Zehra, I., Tracy A. Villareal, Susan Hegarty, & Samantha Woods, Environmental Sciences Program, University of Massachusetts-Boston, Boston, MA 02125.
WINTER PHYTOPLANKTON BLOOM DYNAMICS OF CAPE COD BAY,
MASSACHUSETTS, DECEMBER, 1993 TO FEBRUARY, 1994.**

The winter phytoplankton bloom of Cape Cod Bay was investigated during three cruises: December, 1993; January, 1994; and February, 1994. Discrete samples were taken for: chlorophyll a - total and <10µm size-fraction; nutrients; particulate phosphate and silicate; elemental C,H,&N; and cell counts for species identification and abundances. Preliminary results from these analyses suggest that the bloom in Cape Cod Bay is highly localized - initiating in the Southeast corner of the Bay in January. February results track the blooms' movement north and west however, this move is limited primarily to the shallower waters along the coast. These results are consistent with the idea that blooms arise as a response to increased light levels.

Andrew Schoudel, University of New Hampshire, Durham, NH 03824
SEASONAL VARIATION OF NUTRIENTS IN THE KENNEBEC, SHEEPSCOTT AND
DAMARISCOTTA RIVER ESTUARIES

An ongoing comparative study is aimed at determining the effects of variable freshwater discharge on water column stability and biogeochemical dynamics in the Kennebec (KEN), Sheepscott (SHP), and Damariscotta (DAM) River estuaries in downeast Maine. One of the project's goals is to determine the processes controlling the spatial and temporal distributions of nutrients. Dissolved inorganic nutrients in the samples collected during the fall, winter, spring and summer show seasonal variation. From fall through summer the DAM NO_3^- concentrations vary in space and time (from the head to the mouth of the estuary). The KEN and SHP both show mid-salinity maximum nutrient concentrations during the sampling periods; the maximum concentrations are found adjacent to the city of Bath and the town of Wispensett. In a general sense the nutrient concentrations increase from fall to winter. During the spring period the concentrations decrease and the nutrients show signs of removal in the estuaries. Nutrient concentrations reached a minimum during early summer.

Shea, Beth, and R. Scott Warren, Arboretum and Department of Botany, Connecticut College, New London, CT. 06320

Importance of Undergraduate Research Opportunities through Research Grants

Jobs are becoming harder to find. Therefore, with the ever increasing difficulty in finding a position in the fields of biology and ecology, experience or graduate education may be the deciding factor between competing candidates. That is why programs in which undergraduate students are involved in research are so important to a scientist's future career. These programs give students a chance to do basic research, and those who are involved are more likely to pursue a graduate education. These undergraduate opportunities are also hard to find, but at Connecticut College summer research sponsored by grants are one way in which students can get a head start on a professional degree or placement. Over the past three summers, Conn. has had over thirty students involved in grant sponsored research. Of this group, over half have gone on to complete an Honor's Thesis, and of those, over half have presented their work either at professional meetings or through publications. Therefore, grant sponsored research that employs undergraduate students not only allows the principal investigators to pursue other aspects of the research, but they are also giving talented students a head start in the professional world.

Short, Frederick T. Jackson Estuarine Laboratory, Department of Natural Resources, UNH, Durham NH 03824
RECONSTRUCTING MARINE WETLANDS TO REMEDIATE HAZARDOUS WASTE
CONTAMINATION IN AN ESTUARY

At the conclusion of our two-year study, "An Ecological Risk Assessment for Portsmouth Naval Shipyard, Kittery, Maine," specific sources of contamination- and areas of potential contaminant release have been identified. Among these, we identified the movement of contaminated ground water from the Jamaica Island Landfill into the Great Bay Estuary. Only small-volume flows of contaminated water have been found, but the potential for contaminant movement through this pathway remains a risk that requires remediation. The typical environmental remediation action for a contaminated landfill area is capping and sealing. However, such remediation may not eliminate the contaminated groundwater flow and creates a biologically unproductive environment. We have proposed to use the technologies of marine wetland creation and restoration to construct vegetated habitats around the shoreline of Portsmouth Naval Shipyard, adjacent to the Jamaica Island Landfill. Such ecological remediation will interrupt and intercept the flow of contaminated ground water from the landfill, prevent tidal infusion into the landfill, and trap and bind particulate contaminants that are continually resuspended and redistributed within the fine-grained sediments around the Shipyard. The construction of new salt marsh and eelgrass habitat will help to replace similar environments filled or dredged around the Shipyard in the past and will renew the functional values typically provided by these habitats to the estuarine environment. The challenge now is to convince government regulators, environmental groups, and the public, that this is an idea worth trying.

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Effects of different land use on the degradability of dissolved organic matter in water entering an estuary from a forested, an agricultural (a horse farm), and an urban watershed were studied using bacterial incubations. Changes in bacterial numbers, dissolved oxygen, and dissolved organic carbon (DOC) were analyzed at several time points over three weeks. *The* greatest bacterial activity occurred in the agricultural water. Bacteria populations increased at a faster rate in the horse farm samples than in the other two sites. Bacterial consumption of both DOC and oxygen were significantly greater in the horse farm samples than in the dry forest or urban samples. The percentage of the total DOC pool consumed was very similar between sites: 15.7%, 10.3%, and 11.0% in the dry forest, horse farm, and urban samples, respectively. Results imply that agricultural runoff should have the greatest impact on the estuarine environment, supplying it with a large amount of degradable dissolved organic material, which will contribute to the pelagic food web.

Spatial patterns of phytoplankton biomass and chemical composition in Cape Cod Bay during Aug. 1993. T. A. Villareal, S. Hagerty, S. Woods, Z. Schneider, & G. Gardner. Env. Sci. Progr., Univ. of Mass., 100 Morrissey Blvd., Boston, MA 02125.

Phytoplankton species composition, biomass and chemical composition were examined in Cape Cod Bay (CCB), MA during August, 1993. During this period, the Bay was highly stratified with a particularly pronounced pycnocline along the eastern edge. Shoaling isothermals suggested recent upwelling along the western side; however, nutrient concentrations were low in surface waters throughout the bay except near Plymouth Harbor. Only a weak sub-surface chi maximum was present. The <10µm size fraction dominated at the surface throughout the Bay. A shift to the > 10 µm size fraction was noted at the SCM, and in some of the deep samples. Species counts noted a numerical dominance by monads/flagellates with localized maxima of the diatoms *Thalassionema nitzschiodes*, *Asterionellopsis glacialis* and *Thalassiosira* spp. Particulate ratios suggested N rather than P was probably limiting.

Waterman, Ernest R. P., Waste Management Division, U.S. Environmental Protection Agency, Region I, Boston, MA 02203
REMEDY SELECTION IN HAZARDOUS WASTE SITE CLEANUP

Selection of cleanup measures at hazardous waste sites is a public decision making process. The constraints of regulatory decision making criteria (e.g. long-term effectiveness, proven reliability, community acceptance) imposed by this process potentially inhibit introduction of new and innovative technologies and create barriers of which the scientific researcher may be unaware. In this presentation we examine the decision making issues and criteria that confront wetland reconstruction proposals at Portsmouth Naval Shipyard.

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AN ASSESSMENT OF ESTUARINE RESEARCH PROGRAMS FOR TEACHERS AT PROJECT OCEANOLOGY

Over 60 middle school and high school science teachers have participated in three 3-year marine research programs at Project Oceanology, funded by the NSF Teacher Enhancement Program. Working in teams, the teachers conducted interdisciplinary studies of estuarine processes in the Thames River and Boston Harbor. They presented the results of their work at various scientific conferences, including NEERS and AAAS. They implemented marine research programs in their own schools, involving students in inquiry oriented science. A number of the teachers have received grants to support this research. An evaluation of the teacher research program will be presented and its impact on the curriculum of one of the participants will be described.

Welsh, Barbara I, Marine Sciences Department, University of Connecticut, Avery Point, Groton, CT 06340.

ON THE MERITS OF UNDERGRADUATE PROGRAMS IN MARINE SCIENCE/STUDIES.

At UCONN we are responding to student demands for more undergraduate education in "matters marine". We traditionally offer undergraduate courses in Marine Biology, Marine Geology and Descriptive Oceanography to students who wish to begin specializing in oceanographic processes within a classical scientific discipline. This new direction represents a basic philosophical change, since Marine Sciences is a graduate department. While not unanimous about it, we do feel obliged as educators to explore the merits and feasibility of such requests. We presently have three programs under consideration: 1) Maxine Resources Management and Technology, residing within the School of Continuing Education, and culminating in a Bachelor of General Studies, 2) Environmental Science with a Marine Science concentration, culminating in a Bachelor of Science, and 3) Marine Studies, culmination in a Bachelor of Science or a Bachelor of Arts. Demands and limitations of these three programs will be discussed.