New England Estuarine Research Socety

NEERS

Spring Meeting
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Salem State College
Salem, Massachusetts

ABSTRACTS
of

Presented Papers & Posters

Barr, Bradley W. NOAA/Stellwagen Bank National Marine Sanctuary, 14 Union Street, Plymouth, Massachusetts 02360
THE STELLWAGEN BANK NATIONAL MARINE SANCTUARY...A SANCTUARY FOR RESEARCH (No Kidding!)

Designated on 4 November, 1992, the Stellwagen Bank National Marine Sanctuary comes on line as the nation's 12th, and New England's first, National Marine Sanctuary. As research is one of the principal mandates of the Sanctuary, an essential part of the implementation of the designation is the development of a 5-year research and monitoring agenda. To assist the Sanctuary staff in establishing such an agenda, members of the research community assembled in early April to discuss what is known, what we would like to know, and in what order we would like to have these questions answered, as regards the physical, chemical, and biological components of the Stellwagen Bank ecosystem. The results of this symposium will be presented, as will how the agenda is to be used to help leverage funds out of fiendishly clever federal funding agencies.

Other topics of interest to researchers who are or anticipate working in the Sanctuary are also likely to be raised for discussion during the presentation.

Beatty, Lynn. Graduate School of Oceanography, University of R.I., Narragansett, RI 02882 CHANGES IN THE BENTHIC COMMUNITY WITH SALINITY AND HABITAT TYPE

As part of an ecological evaluation of the Bass Harbor Marsh estuary in Acadia National Park, Maine, benthic macrofauna were sampled periodically from October *1990* through August 1992. Stations, ranging from high to low salinity, were selected to represent the major habitat types of this system. A striking gradient in benthic community composition existed along the estuary. Oligochaetes were most numerous just outside the estuary in adjoining Bass Harbor, comprising 76% of total animal abundances. Polychaetes (e.g. *Streblospio benedicti, Capitella capitata, Tharyx acutus, Pygospio elegans)* predominated at the two lower estuarine stations (42-48% of the total), but were virtually absent from the upper estuary. Mollusks were also important at the higher salinity sites, particularly the gastropod *Hydrobia ininuta* which comprised 42% of total abundances at the station dominated by the macroalgae *Cladophora.* Midge larvae (family Chironomidae) and amphipods *(Gammarus* sp.*)* were abundant (67-74% and *9-11%* of the total, respectively) at the two upper estuarine locations dominated by the angiosperms *Ruppia* and *Potamogeton.* Both salinity and habitat type were important factors in influencing benthic species composition. Although opportunistic species that are often indicative of nutrient enrichment dominated most sites, the results do not necessarily indicate enriched conditions because of moderate animal abundances and high species diversity. However, this could change in the future if there is a significant increase in animal numbers or a change in community structure with one or two species becoming predominant to the exclusion of other species.

Berman, Jody. Zoology Department, University of New Hampshire, Durham NH

DO ESTABLISHED COLONIES ALTER THE ABUNDANCE OR DISTRIBUTION PATTERN OF LATER ARRIVALS?

The relationship between substrate type and recruitment patterns were exmined using two species of colonial ascidian *(Botrylloides diegensis* and *Botryllus schlossert).* Field and laboratory experiments were conducted to test whether recruitment rates or distribution patterns varied in response to the presence of either established conspecific or nonconspecific colonies. Results for abundance were highly variable; patterns of recruitment observed differed as a function of experiment, site and trial. Measurements between pairs of co-recruits indicated that non-conspecifics were avoided, while distances between recruits and established colonies indicated that no such preference existed. I am currently analysing these results using more robust geostatistical techniques and plan to present the results at this meeting.

V. M. Berounsky, K.R. Hinga, V. Lee, S.W. Nixon, M.E.Q. Pilson, A. Desbonnet, A. Keller, B. Kopp, S. Pavignano, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI and D.W. Stanley, East Carolina University, Greenville, NC

EXAMINING ESTUARINE EUTROPHICATION: THE ROLE OF VOLLENWEIDER, CHLOROPHYLL, NITROGEN, AND TIDAL RANGE

Existing 1980's data from twelve estuaries, all included in the National Estuarine Program of the Environmental Protection Agency, were used in a cross-estuary approach to study estuarine eutrophication and attempt to find a "Vollenweider-type" relationship between nutrients and chlorophyll. Data were assessed for monthly values of nutrient concentrations, nutrient loading, light availability, phytoplankton parameters, oxygen conditions, macrophytes and benthic organisms. Estuaries were segmented based on salinity ranges and nutrient loading sources. Much scatter was found in the relationship between concentrations of dissolved inorganic nitrogen (DIN) and chlorophyll, and similar scatter was also seen in Vollenweider's (1976) phosphorus vs. chlorophyll relationship, at the range of chlorophyll seen in the estuaries. Stronger relationships between DIN and chlorophyll were found when estuarine systems with higher and lower DIN were included. The strongest relationship was found for replicate mesocosms with various levels of ammonium enrichment. For multiple estuary data, the strongest relationship was found when all types of systems were included, but only those with tidal ranges less then 1.4m.

Buchsbaum, Robert. Massachusetts Audubon Soc. Wenham, MA 01984
PLUM ISLAND SOUND: WORKS IN PROGRESS.

Plum Island Sound, a 4470 acre estuary in northeastern Massachusetts, is well-known regionally and nationally as a place where the world renowned Ipswich clams are harvested, as the center of the Parker River National Wildlife Refuge, and as a major anadromous fish habitat. It is surrounded by 8400 acres of salt marshes, comprising part of the largest contiguous acreage of salt marsh north of Long Island. Two major rivers, the Parker and the Ipswich and a number of smaller rivers and tidal creeks drain into the Sound.

The Sound has been generally been considered a pristine area with a relatively undeveloped shoreline and much undeveloped land in the surrounding watersheds. There is only one permitted discharge into the Sound. Recently, however, the Sound has suffered from nonpoint source pollution from fecal coliforms to the point where it is routinely closed to shellfishing after rainfalls of a half inch or more. It is hard to determine whether this represents a deterioration of water quality itself recently or whether our awareness of past problems has increased because of more intense sampling. Around the turn of the century, there were many small mills and other industries on the Sound and its tributaries, so its past history may not have been as "pristine" as generally thought today. The major sow-ces of pollution to the Sound are from the rivers; there is little direct input.

The ecology and geology of the Sound has been examined intensively since the 1960's, with particularly emphasis on fisheries, salt marsh nitrogen dynamics, and fecal coliform contamination. These research themes are continuing in two ongoing research projects, the Woods Hole Ecosystems Center's Land Margin Ecological Research (LMER) program and the Massachusetts Audubon Society's Minibay Project of the Massachusetts Bays Program.

Carey, D., Murray, P., SAIC, 221 Third St., Newport, RI 02840, and
Fredette, T. US Army Corps of Engineers, Waltham, MA 02254
HISTORICAL DEPOSITION OF INDUSTRIAL WASTE IN MASSACHUSETTS BAY

Evidence of the historical disposal of industrial waste was obtained during a recent survey of the Massachusetts Bay Disposal Site (MBDS), located within Stellwa9en Basin. The MBDS overlaps the historical area for waste deposition, the Industrial Waste Site (IWS), where industrial wastes were disposed from the early 1900s to 1976. The IWS received radioactive and hazardous wastes, as well as construction and dredged materials. Data were collected using traditional marine technology (sediment chemistry, acoustics), and enhanced with results obtained with laser imaging. Sediment samples indicated the presence of isolated patches of high concentrations of PAHs. Sidescan sonar images were used to track specific large targets (e.g., dredged material and sunken barges). Recently-developed laser linescan technology was used for high-resolution imaging of small targets, including corroded hazardous waste containers. Maps of specific targets of industrial waste, from sediment "hot spots" to remnants of waste containers, will be used to identify areas within the MBDS that are prime candidates for receiving new dredged material suitable for open ocean disposal.

Chase, Bradford. Cat Cove Marine Laboratory, 92 Fort Ave., Salem, MA 01970 MASSACHUSETTS BAY SMELT SPAWNING HABITAT MONITORING PROGRAM

The Massachusetts Division of Marine Fisheries has been monitoring rainbow smelt (Osmerus mordax) spawning habitat since 1988. Smelt are an anadromous species that mature in estuaries and coastal bays and spawn in the freshwater zone of tidal rivers. Smelt have traditional provided a valuable recreational fishery along Massachusetts Bay. Smelt populations have declined sharply during the past 15 years and the causal factors are uncertain. The primary objective of this program is to document temporal, areal, and ecological characteristics of all smelt spawning habitat from the Merrimac River to the Cape Cod Canal. Approximately 35 spawning locations have been identified, with one season of sampling remaining. All populations observed are well below historical levels, even though habitat conditions range from heavily impacted due to urban development to relatively undisturbed. The presentation will outline documented characteristics Df smelt spawning habitat and discuss causal factors observed and suspected to have contributed to the declining populations.

Cleaves, Sam. Salem Sound 2000, 201-203 Washington St. Suite 9 Salem MA, 01970
WATER QUALITY SAMPLING, CITIZEN INVOLVEMENT, & THE MASS BAYS PROGRAM

To develop important information on non-point source pollution, an unsophisticated water quality sampling program was designed for Salem Sound as a part of a comprehensive management strategy funded by the Massachusetts Bays Program.We describe this sampling program as a model which is providing significant and cost-effective data as well as building strong citizen interest and involvement.

Michael S. Connor, Paul Lavery, Kelly Coughlin. State of Boston Harbor:1993 --- An Ongoing Assessment. Environmental Quality Dept.,Massachusetts Water Resources Authority, Boston, MA 02129

For each of the past four years, MWRA has compiled all the monitoring data collected in Boston Harbor to document the restoration of this estuary as pollutant loads to the system are reduced. Successful restoration results in improvements in the three major components of the estuary - -- the water, sediments, and biota. To date, each of these components has responded at a different pace to source reduction.

Water contamination in the harbor has responded most quickly. Concentrations of fecal coliform bacteria are lower in the outer harbor since the cessation of sludge dumping and along many of the beaches fringing the harbor. UMASS researchers have shown that metal concentrations in harbor waters have declined since 1980 as well. Nutrient concentrations in the harbor, however, have not changed.

While sediment contaminant concentrations are likely to change only slowly through time, the area around the old Long Island sludge outfall has been colonized by extensive beds of amphipods since sludge dumping stopped two years ago.

Contaminant concentrations in winter flounder, lobster, and mussels have also slowly declined since 1986. This decline in chemical contamination has been accompanied by a reduction in liver disease in winter flounder caught near the Deer Island effluent discharge.

Cooper, Blair, Dadswell, Mike. Acadia University, WoIfville, N.S.

THE MOVEMENT, MORTALITY, AND GROWTH OF JUVENILE SEA SCALLOPS OFF MEISNER ISLAND IN MAHONE BAY, N.S.

The natural mortality of the juvenile sea scallop *(Placopecten magellanicus) has* never been reliably determined and is difficult to assess because of this species' mobility. Natural mortality can vary within a species based on size and stock characteristics. The hypothesis was that a critical period for sea scallop recruitment is after spat settlement and during the first two years of life. We conducted an experiment to estimate natural mortality, movement, and growth. The experiment involved two field seasons (1992-93), with underwater, natural sites and wild juvenile scallops from two genetic stocks (Mahone Bay, N.S. and Passamaquoddy Bay, N.B.), each with two size ranges (10-20 mm and 35-45mm Sh). The natural mortality found was 19.5% in 1992 and 31.1% in 1993 for the combined genetic stocks and size ranges. The greatest portion of mortality occurred from crab and lobster predation with starfish having some effects mainly on the smaller size class. The mean distance moved was 1.36 ± 1.20 m for 1992 and 1.39 ± 1.36 in for 1993, The growth of the scallops for 1992 were 5.3 ± 1.1 mm for the bottom culture and 7.2 ± 1.4 mm for the suspended control culture. For 1993 the growth was 3.8 ± 1.2 mm for the bottom culture and 4.9 ± 1.1 mm for the suspended culture. Experimental recovery versus control survival showed significantly greater numbers survived in suspended cultures than were recovered from the bottom culture (i.e. p< .01). The methodology allowed a feasibility study of bottom sowing aquaculture.

Davis, Ryan and Frederick T. Short. Department of Natural Resources, Jackson Estuarine Laboratory, University of New Hampshire. Durham, NH 03824

MITIGATING EELGRASS HABITAT LOSS THROUGH CONSTRUCTION OF AN UNDERWATER TERRACE

Eelgrass *(Zostera marina)* habitats are an important estuarine resource and provide critical functions such as shelter, foraging areas, sediment stabilization, water quality enhancement, and nurseries for economically and ecologically important species. We are creating 6.2 acres of eelgrass habitat in the Piscataqua River on the Maine, New Hampshire border to mitigate for impacts to an eelgrass bed incurred by a port expansion project. To truly mitigate, that is to create new habitat where it previously did not exist, we constructed an underwater terrace to provide acreage within the photic and depth range required by eelgrass for survival and expansion. The 0.75 acre terrace was constructed by placing a riprap wall in the river to act as a containment barrier and backfilling the area with estuarine sediments (sandy mud). Sediments were obtained from a site where dredge material had been dumped on a salt marsh; removing these sediments for terrace construction also reclaimed 3 acres of salt marsh. While the terrace did bury existing substrate and benthic habitat, we expect the created eelgrass habitat to provide far greater functional values than the mudflat it replaces. To ensure this, the site will be monitored for the next 15 years to assess functional values such as primary production, habitat complexity, fish use and benthic species diversity. We believe the construction of underwater terraces provides a novel approach for creating habitat of high functional value.

poster Fiore Jr., Edward J. Brooklyn College CUNY, Brooklyn NY 11210 DIET VARIABILITY AND HABITAT UTILIZATION BY KILLIFISH IN JAMAICA BAY, NY

The mummichog *Fundulus heteroclitus* is an important ecological component of estuarine ecosystems but little is known regarding dietary variability in relation to shore level. In 1993, stomach contents from 660 fish trapped from a range of microhabitats including "tall" and "short" *Spartina alterniflora, S. patens,* and highmarsh pannes were investigated. 60% of all fish had food in their stomachs; the amphipod *Gammarus palustris* comprised 60% of prey at low marsh sites, dropping to 24% in the high marsh (where filamentous green algae comprised 47%.) At a non-marsh control site, eggs made up nearly half of all stomach contents. Most fish trapped from the high marsh in July were young-of-the year. The trophic linkage between *Gammarus* and *Fundulus* is significant for energy transduction but also may be a conduit for the transfer of toxic chemicals such as PCBs to higher trophic levels.

Graham, J.J.,Bx6085,Battlement Mesa,Co.,81636
CONFIRMATION OF COASTAL "WATER TYPES",USING SECCHI DISC RECIPROCALS AND EXTINCTION COEFFICIENTS;LARVAL HERRING RESEARCH.

The relation between Secchi disc reciprocals and extinction coefficients confirmed the presence of three differing environmental areas (eastern,central & western)within the coastal water of the western Gulf of Maine. Linear regressions were calculated for measurements with a Secchi disc and photometer made during all seasons. Residual variability about the regression lines exhibited a sinuosity from stations west to east. When compared on probability paper for the three areas, curved lines east and west were apparent with a relatively straight line in the central area. The results suggested that the three areas differed in their optical characteristics,but that eddies near the center of the coast mixed waters from all three areas. Larval herring hatched in coastal water often drifted with the currents later entering bays and estuaries. Therefore,successful forecasting of the sardine harvest appeared unlikely using an ecological correlative.

Guilfoyle, Kerry Jo. Hampshire College, Natural Science, Amherst, MA 01002
THE EFFECTS OF HUMAN EXPLOITATION AND HURRICANE DAMAGE UPON MANGROVES

The purpose of this study was to determine the effects of hurricane and human disturbance upon mangrove plant ecology of Laguna Perias on the Atlantic coast of Nicaragua. I established transacts in three study sites: 1) human exploited, 2) hurricane impacted, and 3) an area not clearly influenced by either of these factors. Within these transects I determined percentage disturbance, stem density, diameter at breast (d.b.h.), height, the number of trees with a height greater than 10m, number of saplings, and percentage of cover by mangrove trees and herbaceous species.
Disturbance was significantly greater in both impacted sites. I found that although there were no significant differences in stem density between sites, in the non-impacted site d.b.h. was higher and there were more trees greater than 10m compared to the impacted sites. The number of saplings was significantly greater in the impacted than in the non-impacted areas. In reference to plant composition, there was a significantly higher percentage of herbaceous species within the impacted areas than in the non-impacted site. There was an inverse correlation between mangrove tree abundance and herbaceous species in all study sites. In addition, there was a direct correlation between abundance of herbaceous species and percentage disturbance as well as an inverse correlation between mangrove trees and percentage disturbance.

Hughes, J.E.. Institute of Marine and Coastal Sciences, Rutgers University, New Brunswick, NJ 08903-0231
SEASONALLY-VARIABLE IMPACT OF A DEPOSIT-FEEDING POLYCHAETE ON SEDIMENTARY MINERALIZATION

Mediomastus ambiseta (Polychaeta: Capitellidae) stimulated the mineralization of sedimentary organic matter to a greater extent in fall-collected than in spring-collected sediments of central Narragansett Bay, Rhode Island. The two sediments likely differed in organic matter content and bacterial activity. The results of microcosm experiments suggest that *M. ambiseta* enhances the mineralization of older, more refractory detritus, but has less effect on more recently-deposited material, corroborating studies with other deposit-feeders.

Hyland, Jeffrey, NOAA/NOS, 217 Fort Johnson Rd, Charleston, S.C. 29412, MANAGER CAROLINIAN PROVINCE OFFICE; and Costa, Helder, Arthur D. Little, Inc., 20 Acorn Park, Cambridge, MA 02140-2390, SENIOR CONSULTANT.

SEDIMENT CONTAMINANTS IN MASSACHUSETTS AND CAPE COD BAYS

Sediment samples were collected during July 1993 at 12 stations in Massachusetts and Cape Cod Bays along the Massachusetts coastline. The stations consisted of four sites from shallow subtidal depths (0.3 to 5.1m MLLW) in each of three harbor systems: Wellfleet Harbor, Boston Harbor, and Salem/Beverly Harbors. Synoptic measurements were made of pollutant concentrations (total hydrocarbon content, individual polynuclear aromatic hydrocarbons, chlorinated pesticides, polychlorinated biphenyls, and metals), sediment/porewater toxicity, and benthic community structure as a basis for examining potential linkages between sediment contamination and adverse impacts on living benthic resources of the Massachusetts Bay/Cape Cod Bay nearshore ecosystem. The data were examined to: (1) to determine whether contaminants in sediments at any of these sites were present at concentrations known to cause adverse effects on marine organisms; (2) to determine whether sediments and/or sediment pore water collected at the 12 stations were significantly toxic to test populations of marine organisms (amphipod *Ampelisca abdita* and sea urchin *Arbacia punctulata)* based on comparisons of survival and other sublethal biological responses in negative controls; (3) to examine patterns in macroinfaunal community structure among the various sites and identify any signs of pollutant-related stress in these assemblages; (4) to examine relationships between the chemical, toxicological, and biological data as a means of identifying sites where sediment contamination could have been responsible for observed bioeffects (significant toxicity responses and/or altered benthic community structure); and (5) to compare differences in contaminant trends and degree of biological impacts among the three harbor systems. Results addressing these key objectives will be presented.

Jaworski, Norbert A., U.S. Environmental Protection Agency, Environmental Research Center, 27 Tarzwell Drive, Narragansett, RI 02882 and Robert W. Howarth, Rm E311, Ecology and Systematics, Cornell University, Ithica, NY 14853.

COMPARISON OF THE NUTRIENT LOADINGS FOR THE SEVEN MAJOR ESTUARIES OF THE NORTH EAST.

Using data from the various estuaries' characterization efforts of the National Estuary Program (NEP) and other studies, the authors have estimated nutrient loadings from point and non—point sources for the seven major estuaries of the North East.

A comparison of these loadings (normalized in terms of kilograms/Km^2/yr) is made for total organic carbon, phosphorus and nitrogen. A comparison of the total N/P ratio is also provided.

poster Keller, A.A., P. Hargraves, H. Jeon, G. Klein-MacPhee, C. Oviatt and J. Zhang. Graduate School of Oceanography, URI, Narragansett, RI 02882
THE EFFECTS OF ULTRAVIOLET-B RADIATION ON MARINE TROPHIC LEVELS DURING A WINTER-SPRING BLOOM.

The objective of our recent research at the Marine Ecosystems Research Laboratory (MERL) was to examine the effects of enhanced UV-B radiation on the pelagic trophic structure of a well mixed coastal ecosystem during the winter-spring bloom.The experiments were conducted in six large scale (13,000 L) marine ecosystems: three control systems with the naturally occurring UV-B light field and three experimental systems exposed to increases in UV-B radiation of -100%. The experiment was devoted to examining trophic effects (direct and indirect) at the level of the primary producers (photosynthetic algae), primary consumers (zooplankton) and secondary
consumers (ichthyoplankton).Preliminary results suggest that only direct effects have been detected.Phytoplankton biomass and species composition were not significantly different between control and treatment mesocosms. *Acartia hudsonica* (adults), the dominant zooplankton during the bloom period, exhibited decreased abundance in the UV-B treatment tanks. Mortality of winter flounder *(Pleuronectes americanus)* eggs was higher in the upper layers (0.1 and 0.5 m) of the treatment tanks but not the lower levels (1.0 and 2.0 m) relative to controls.

LaMontagne, Michael and Robert Duran. Boston University Marine Program, Woods Hole, MA 02543.
Sources and Sinks of Nitrous Oxide in the Waquoit Bay Estuarine System

We examined sources and sinks of the atmospherically reactive gas nitrous oxide (N_20) in the Waquoit Bay Estuary. Previous studies have shown coastal sediments to be a substantial sink of this gas, and that N_20 production increases with nutrient loading. Flux measurements, using both benthic chambers and core incubations, indicate that sediments can be both a source and a sink of N_20. The mean flux was 200 $nmol/m^2hr$ into the sediments. Clear chambers consumed less N_20 than light chambers; nutrient loading had no detectable effect. Daily shifts in water column N_20 distributions reflected these flux patterns and also indicated a freshwater N_20 source. Groundwater N_20 production may explain this source. Wellpoint samples found high N_20 concentrations in groundwater, and a correlation between groundwater N_20 and nitrate concentrations. This correlation suggests an aquifer sink of available nitrogen. A portion of the dissolved nitrogen entering groundwater may be converted to gasses, like N_20, which are unavailable to primary producers.

Leo, W. S., L. M. Marx, A. C. Rex, Massachusetts Water Resources Authority, Boston, MA 02129. PRIORITIZING WATER QUALITY PROBLEMS.

One of the many sources of pollution to Boston Harbor and its tributaries is the combined sewer overflows (CSOs) that discharge an untreated mixture of stormwater and sewage during wet weather. CSOs intermittently discharge high loads of pollutants, particularly pathogens, at the shoreline, often close to beaches and boating areas. CSOs cause violations of state water quality standards for aesthetics, for sewage indicator bacteria, and sometimes for other parameters. Therefore, the CSO plan now under development must either eliminate CSOs or make a case for a local variance from water quality standards. Eliminating CSOs does not necessarily solve local water quality problems; in some areas, stormwater is the primary source of bacteria and other pollutants. Decisions about changes in water quality standards need to take into account the uses people make of the receiving waters, the likelihood that other sources will be controlled, and the cost of CSO control. Uses, water quality, hydrodynamics, and relative importance of CSO as a source all vary between different areas of the receiving water, so we divided the study area into fourteen segments. The results of our analysis to date are presented for three of these, chosen to illustrate a range of conditions.

Mayo, D.[1,2], P. Colarusso[2], S. Kaplan[2], M. Liebman[2], M. Chandler[2] and M. Farrington[2]. 'Biology Department, Salem State College, Salem, MA 01970 and [2]New England Aquarium, Edgerton Research Lab, Central Wharf, Boston, MA 02110.

FISH AND MACROINVERTEBRATES OF EELGRASS BEDS IN BOSTON HARBOR AND
BROAD SOUND

A preliminary survey was conducted to document the use of eelgrass communities *(Zostera marina)* in Boston Harbor and Broad Sound by finfish and invertebrates. This study is part of an effort to document the recovery of eelgrass beds in response to the cleanup of Boston Harbor. One site in Hingham Harbor, the only remaining eelgrass bed within Boston Harbor, and two sites in Broad Sound in Nahant and near the Nahant Causeway (Lynn Harbor) were compared during May - September, 1993. Among the three locations, 23 different fish species were identified. Two species (Atlantic mackerel and bluefish) were unique to the Boston Harbor eelgrass bed. Eight species were unique to the Broad Sound eelgrass beds including a number of groundfish (Atlantic cod, white hake, pollock, windowpane flounder). The macroinvertebrate sampling determined that 16 species of crustaceans were present, nine of which were common to both areas. Four species were unique to Broad Sound and three were unique to Boston Harbor. Eight species of gastropods were identified; five species were common to both areas and three species were unique to Boston
Harbor.

poster Moore, Johnes K. Salem Sound 2000, 201-203 Washington St. Suite 9, Salem, MA 01970.

SALEM SOUND 2000: THE TIDAL MIXING OF METAPHORES AND A SEAGRASS ROOTS APPROACH TO MARINE POLICY ON THE NORTH SHORE

We describe this interesting initiative and how aging, retired professors can find the salt fountain of youth. Parental guidance advised.

Morss, M. S.[1], D. G. Colarusso[1], M. J. Moore[2] and M. G. Tyrrell'. [1]Stonehill College, North Easton, MA 02357 and [2] Woods Hole Oceanographic Institution, Woods Hole, MA 02543.

A COMPARISON BETWEEN HISTOLOGICAL GRADING AND QUANTITATIVE IMAGE ANALYSIS OF LIVER PATHOLOGY IN WINTER FLOUNDER.

Histological grades of winter flounder liver pathology have been generated annually since 1987 on winter flounder from Boston Harbor, and elsewhere in the Mass. Bays. Our aim in this study was to compare visual assessment of the severity of specific lesions with digital image analysis. Samples collected in 1992 were analyzed histologically for the grade of specific lesions on a range of 0, absent, through 4, severe. Images of the same samples were thresholded to allow digital measurement of the surface area of each view occupied by particular lesion types. Data generated for 10 animals from each of 5 stations revealed a correlation coefficient of 0.886 for macrophage aggregation when the two methods were compared. Of the two methods, visual assessment is significantly quicker and from this study appears to be adequately objective.

Murray, P., Carey, D., SAIC, 221 Third St., Newport, RI 02840, and
Fredette, T. US Army Corps of Engineers, Waltham, MA 02254
MAPPING SEDIMENT TEXTURE AT THE MASSACHUSETTS BAY DISPOSAL SITE

Sediment texture and bathymetry were mapped at the Massachusetts Bay Disposal Site (MBDS), an area recently designated as an Ocean Dredged Material Disposal Site. The boundary of the MBDS was located to avoid overlap with the Stellwagen Bank National Marine Sanctuary, and to incorporate an area where contaminated sediments, present as a result of past disposal practices, have been identified. Several acoustic sources were used, including a high frequency transducer for precision bathymetry, a lower frequency transducer for shallow subbottom sediment texture, and a sidescan sonar system. Sediment samples were analyzed for bulk density and grain size. Acoustic and sediment data were used to produce a comprehensive acoustic seafloor texture map. Dominant grain sizes at the MBDS were mapped in the larger context of regional sedimentary environments within Massachusetts Bay. The most recent disposal of coarse dredged material, originating from the Boston Harbor Third Harbor Tunnel construction project, was clearly delineated as a topographic high with corresponding high-reflectance material in both the shallow subbottom and sidescan results. In contrast, ambient sediments typical of the relatively calm Stellwagen Basin consisted of low-reflectance fine-grained silts and clays.

Nowicki, Barbara L., John R. Kelly (1), Edwin Requintina, and Donna Van Keuren. Graduate School of Oceanography, Narragansett, R.I. 02882. and (1) Battelle Ocean Sciences, Duxbury, MA. 02332

DIRECT MEASUREMENTS OF NITROGEN LOSS THROUGH DENITRIFICATION IN BOSTON HARBOR AND MASSACHUSETTS BAY

Aside from dilution and export, sediment denitrification is the only mechanism available for permanently removing nitrogen from Boston Harbor and Massachusetts Bay. Direct measurements of sediment denitrification have been made on cores taken over a two-year period from six stations in Boston Harbor and six stations in Massachusetts Bay. Rates of denitrificat$_i$on in Massachusetts Bay (mean = 22, range = <5-54 μmol N2 m^{-2} h^{-1}, n=29) were significantly lower than those observed in Boston Harbor (mean = 60, range <5-206 μmol N2 m^{-2} h^{-1}, n=26). In the Harbor, rates were most strongly correlated with temperature, but were also influenced by sediment organic content and macrofaunal activity. In the Bay, where the annual temperature range is smaller, sediment carbon content may prove to be a better predictor of denitrification rates.

poster Pitman, J. R. Salem Sound 2000, 201-203 Washington Street, Suite 9,
Salem, MA 01970.
UNDERWATER MARINE PHOTOGRAPHS OF SALEM SOUND

A display of color photographs by three local divers illustrating underwater marine life. These photos highlight the variety and color beneath the surface of Salem Sound, Salem, Massachusetts.

Shea, B. A.[1] K. Y. Liu[2], and R. S. Warren[1]
Department of Botany, Connecticut College, New London, CT 06320[1] and Waterford High School, Waterford, CT 06385[2]

HISTORIC DEVELOPMENT OF THE MAMACOKE TIDAL MARSH, WATERFORD, CONNECTICUT

The objective of this study was to determine the historical pattern of development for the Mamacoke Island tidal marsh. The marsh is located *ca.* 8 km from the mouth of the Thames River in Waterford, CT; *ca.* 2.0 ha in extent, it connects the mainland with Mamacoke Island. River water at this point is mesohaline and marsh peat salinities vary seasonally and spatially from 15 to 23‰. Although these salinities are characteristically brackish, the marsh vegetation is more typically salt marsh with stunted *Spartina alterniflora, Juncus gerardii, Distich/is spicata,* and *Spartina patens* dominating the highmarsh and *Iva frutescens* along the upper border. Basal topography was measured on a 15 x 15m grid by probing the peat with a 12.5 cm rod until resistance. Thirty-five surface to basement peat cores were also taken on the same grid. These were analyzed for percent abundance by species of roots and rhizomes at one cm intervals. These abundances were used to construct historic vegetation maps at 0.5m intervals from the surface to basement These historic maps were compared to a microrelief and vegetation map of the modern marsh surface. In addition, one core was taken for pollen analysis from the deepest portion of the marsh (1.9m) and sampled at 5 cm intervals. Pollen horizons were used to broadly date the core. The significant rise in *Ambrosia* was assumed to date colonial land clearing *(ca.* 1635-1650) and disappearance of American Chestnut was dated as 1935. In addition to these procedures, a microrelief and vegetation map was made of the marsh surface.

Warren, R. S. and Erika L. Buck. Department of Botany, Connecticut College, New London, CT 06320-4196

INVASION AND SPREAD OF *PHRAGMITES AUSTRALIS* ON THE TIDELANDS OF THE LOWER CONNECTICUT RIVER: PRELIMINARY FINDINGS.

Reed grass *(Phragmites australis)* has been a minor component of the vegetation on Connecticut River tidal wetlands for over 3000 years. Today it is a dominant, appears to be increasing rapidly, and its dense monocultures displace typical brackish marsh vegetation. A principal objectives was to determine rates and describe patterns of reed establishment and spread on the oligohaline Goose Island and Lords Cove marshes and the more mesohaline wetlands of the lower Lieutenant River and Great Island. Expansion rates were determined by plainmetery of historic aerial photographs. Reed dominace increased linearly *(ca.* 2% yr^{-1} on oligohaline and *ca.* 1% yr^{-1} on mesohaline marshes). Extrapolating to zero cover gave dates in the mid and late 1960s. Growth rates of individual clones varied by over an order of magnitude at both Goose Island/Lords Cove (>1000 m^{-2} yr^{-1} to <100m^{-2} yr^{-1}) and the lower Lieutenant River/Great Island (> 400m^{-2} yr^{-1} to < 60m^{-2} yr^{-1}). Five pairs of transects (reed dominated/reed free), with soil water wells 3m, 10m, and 30m from the creekbank, were established along a salinity gradient from Great Island (summer mean creek salinity = 17.3‰) to the lower Lieutenant River (8.3‰). One m deep peat cores were removed for each well; species composition of roots and rhizomes was estimated at lcm intervals. Salinity and water table depth were sampled weekly over the summer. Reed was not found at mean salinities >16‰. There was no pattern of water table and reed distribution. Stem height, density, and live and dead biomass were sampled at reed dominated wells; all parameters correlated with salinity. Reed tends to preferentially invade creek and river bank levee sites; the 3m and 10m wells had significantly lower water table depths than the 30m wells.

Weiss, H. M., D. Dauphinais, H. Dimmick, S. Dugas, L. Hahn, C. Hodson, J. LaPointe, C. Low, J. McBride, M. Meyers, C. Orban, E. Parham, M. Quinlan, T. Siekman, R. Stec, S. Green. Project Oceanology, Avery Point, Groton, CT 06340 (203) 445-9007

Spatial and Temporal Variability in Boston Harbor

The spatial and temporal variability of water quality, benthic community, and sediment characteristics in Boston Harbor was investigated at 8 stations along 2 transects, from Dorchester Bay and the Inner Harbor to Broad Sound. Sampling occurred at approximately monthly intervals (except Jan.-Mar.) from July, 1992 through August, 1993. Measurements were also made over several 24 hour periods and at different phases of the tidal cycle. Parameters studied included salinity, temperature, dissolved oxygen, chlorophyll a, phytoplankton, nitrates, nitrites, ammonium, sediment particle size, sediment percent organics, and benthic infauna. Results were generally consistent with a hypothesis that the large tidal amplitude in Boston Harbor produces a well-mixed and well-flushed system. This study was carried out by 15 science teachers with support from the NSF Teacher Enhancement Program.

Welsh, Barbara L. Marine Sciences Department. Univ. of CT. Groton, CT 06340
NEW MECHANISMS OF SEASONAL OXYGEN DEPLETION IN LONG ISLAND SOUND

Annual episodes of oxygen depletion begin about mid-June as the Sound becomes thermally stratified to a point where wind and tides no longer effect sufficient vertical mixing to replenish oxygen supplies below the pycnocline. Bottom water becomes increasingly depleted until mid-August or early September, when heating of the surface layer slows down. The thermal gradient weakens until winds and tides again gain control and the water column is rapidly mixed and reoxygenated. Stratification may recur for briefly, but never for long enough to deplete oxygen to the low summertime levels. Winds pick up, in situ production declines, water temperature falls (and along with that respiration rates decline and physical oxygen saturation levels rise). The water column thus resumes its well-oxygenated state until the following spring. It would seem that we have the process of seasonal oxygen depletion well worked out - or do we? There appear to be some neglected features in this paradigm: (1) the contributions of down-estuary loading (chiefly from the Connecticut River) to eutrophication in the central and western basins, and (2) the effects of organic loading of carbon and nitrogen. If only 28% of the Connecticut River discharge passes up-estuary across Mattituck Sill, the present estimates of riverine nutrient loading will need to be doubled. If DOM loading forces the system through the microbial loop, it will have an immediate and direct impact on oxygen depletion (as opposed to nutrient loading, which is indirect).

Whitten, Jerrard J., Langan, Richard, Frick, George E., Morris, Douglas E., Department of Resource Economics and Development, Department of Zoology, Jackson Estuarine Laboratory, University of New Hampshire, Durham, NH 03824. **Economic Potentials for an Aquaculture Based Oyster Harvest in New Hampshire**

Historical records and Department of Fish and Game surveys have revealed existence of a sizeable oyster (*Crassostrea virginica)* population in both the Great Bay of New Hampshire as well as in tributary water sources. Development on surrounding shorelines as well as a lack of proper water classification has forced a closure of most beds due to potential violations of safety standards. These restrictions have left only a small area of Great Bay for recreational harvest. The majority of NH oyster beds are located in "Restricted" waters. Recent studies have shown that relay and depuration techniques may be used whereby oysters in these "Restricted" waters may be harvested and purified in a controlled manner thereby dramatically increasing safety. With this in mind, information supporting potential oyster bed rehabilitation combined with aquaculture techniques has been applied to three oyster beds - currently closed to all shellfish harvest. Estimates for annual oyster production were made for the Bellamy river, the Oyster river and the Piscataqua river for a ten year period. The study considered relay from harvest site to federally approved waters, then depuration using ultraviolet light which reduces harmful bacteria. Using established oyster bed rehabilitation and aquaculture techniques combined with relay and depuration methods, economic potentials were estimated for New Hampshire produced oysters.