New England Estuarine Research Society

NEERS SPRING 1992 MEETING
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Wendy Smith, Local Meeting Organizer
Bernard McAlice, Program Organizer

ABSTRACTS

Allen, E. A. and P. E. Fell, Zoology Department, Connecticut College, New London, CT 06320 (203) 439-2132.

FEEDING PATTERNS OF *Fundulus heteroclitus* ON *A* RESTORED IMPOUNDED MARSH AND ON ADJACENT UNIMPOUNDED AREAS OF THE WEQUETEQUOCK-PAWCATUCK TIDAL MARSH SYSTEM, STONINGTON, CT.

We examined the feeding patterns of fish collected in mosquito ditches/creeks of three marsh regions: a restored impounded valley marsh, a marsh immediately downstream from the impoundment dike, and a nearby unimpounded valley marsh. Fish were trapped with a hoop met on rising and falling spring tides. For each sample, fish were divided into three size classes (<5cm, 5-6cm and >6cm TL). The diets of fish from all three marsh regions were similar. The four major food items in order of decreasing abundance were detritus, algae, amphipods and copepods. Large fish consumed more amphipods and insects than did smaller fish, but detritus was the most abundant component of the gut content of all size classes.

Armstrong, Michael P. Zoology Department, University of New Hampshire, Durham, NH 03824 (603) 862-3665

OCCURRENCE, INTENSITY AND EFFECTS OF A MICROSPORIDIAN PARASITE ON WINTER AND SMOOTH FLOUNDER FROM GREAT BAY ESTUARY, NH

Mortality resulting from parasitic infections is commonly overlooked as a source of fluctuations in population sizes. Winter *(Pleuronectes americanus)* and smooth *(Pleuronectes putnami)* flounder are hosts to the microsporidian parasite, *Glugea stephani.* In this study, the incidence of infection in winter flounder (65%) was much higher than previously reported in the literature, and much higher than in smooth flounder (3%) residing in the same estuary. Twenty-two percent of YOY winter flounder were heavily infested. These individuals were severely emaciated, resulting from damage to their digestive tracts, and subject to high mortality. The difference in infection rates between the two flounders appears to be related to differences in the consumption of the parasite vector and slight differences in habitat usage. *Glugea* should be considered a significant cause of mortality in juvenile winter flounder.

Jody Berman, University of New Hampshire, Zoology Department, Durham, NH 03824, USA. (603) 826-3665.

INVASION OF THE GREAT BAY ESTUARY, NH BY BOTRYLLOIDES DIEGENSIS: ESTABLISHMENT, PERSISTENCE AND INTERACTIONS WITH BOTRYLLUS SCHLOSSER[

The introduced ascidian Botrylloides diegensis has undergone dramatic changes in abundance within Great Bay over the past 20 years. Changes in abundance of this exotic species were mirrored by changes in the abundance of the "native" species Botryllus schlosseri. These contrasting patterns of abundance indicated the potential for negative interactions between these closely related and ecologically similar species. This ongoing research examines 4 questions regarding the distribution and abundance of B. diegensis and B. schlosseri. (1) Does their relative competitive ability differ? (2) Does the distribution of adult colonies differ within Great Bay? (3) Does the larval recruitment of these species differ within Great Bay? (4) Is larval settlement altered in response to the presence of established colonies? Results are examined with respect to alternative views of the mechanisms of establishment and means of persistence of invasive species in general, with particular attention to B. diegensis.

Bigford, Thomas E. NOAA/National Marine Fisheries Service, Habitat and Protected Resources Division, 1 Blackburn Drive, Gloucester, MA 01930-2298 (308) 281-9209

HEIGHTENED ENVIRONMENTAL CONCERNS IN FISHERIES MANAGEMENT

New policy and ecological expectations are expanding the breadth of fisheries management programs. Resulting programs promise to reflect an ecosystem philosophy, with greater consideration for by-catch of non-target species, incidental take of protected species, effects of fishing gear on habitats, and the overall health of essential habitats, among other topics. Fishery management plans and associated environmental documents are being revisited, and amended where appropriate. This shift has major implications to researchers, managers, and resource users. Many of the issues included in this ecosystem approach are not very well understood. Those issues and challenges will be outlined in this talk.

Buchsbaum, Robert. Massachusetts Audubon Society, 58 Hesperus Avenue, Gloucester, MA 01930 (508-927·1122)

BIRDS IN THE BUFF: THE EFFECT OF NATURAL AND DEVELOPED BUFFERS ON THE - DISTRIBUTION OF BIRDS IN ESSEX BAY (MASSACHUSETTS)

We are *currently* examining the effect of land use patterns, particularly development on the periphery of coastal wetlands, on the distribution of aquatic birds in Essex Bay, MA. In Massachusetts, activities In a wetland and a 100 ft buffer are regulated by the Wetlands Protection Act, however there is little data on whether a 100 foot buffer is generally adequate for protecting wildlife values of the wetland,

Our censuses revealed differences In the effects of buffer development among different guilds of birds. Waders (herons, egrets, ate.) are more likely *to be found in areas furthest from* human habitation, Waders are most common on remote salt marsh islands and are more common along an undeveloped salt marsh creek than a creek surrounded by Mouses. Migratory shorebirds also prefer less developed areas, but this may be more related to the presence of an undeveloped barrier beach than to development In uplands surrounding the bay. Waterfowl are more abundant in less developed sections, but their overall numbers are low. Interpretation of the results Is complicated by a variety of factors contributing to patterns of distribution in the bay.

Burdick, David M. and Frederick T. Short. Department of Natural Resources and Jackson Estuarine Labor-atory, University of New Hampshire, Durham, NH 03824 (603) 862 -2175

EFFECTS OF WASTING DISEASE ON POPULATIONS OP EELGRASS CULTURED UNDER CHRONIC LIGHT AND NUTRIENT STRESSES

Eelgrass was planted in twelve mesocosms and maintained for two months under two light levels (60 and 25% of full surface sunlight at 1 cm depth) and three nutrient loading rates (ambient: that received from Great Bay waters, reduced; one half of ambient rates, and enriched: 11 times ambient rates) in a factorial treatment arrangement, On October 20, salinity was raised and maintained at levels between 26 and 30 ppt, and four diseased plants were introduced into each tank. Twelve plants from each tank were planted in plastic cups and disease spread was monitored weekly from October 22 through November 25. Incidence of disease, as measured by the wasting index, increased over time and increased more rapidly under reduced light Although reduced light and nutrient enrichment encouraged rapid disease spread and death of individual shoots, these conditions reduced the severity of the disease in populations by reducing eelgrass standing crop. Thus transmission of the disease between shoots, which requires leaf-to-leaf contact, was reduced. In natural populations where light and nutrient stresses are variable, dense beds already infected with the disease could succumb quickly when reduced light and elevated nutrient stresses occur.

Carlson, Noel C., Dept. of Natural Resources and Jackson Estuarine Lab. Frederick T. Short, Dept. of Natural Resources and JEL, University of New Hampshire, Durham, NH 03824. DETERMINATION OF LIGHT .REQUIREMENTS NECESSARY FOR SUCCESSFUL REESTABLISHMENT OF THE SEAGRASS, *ZOSTERA MARINA* L.

Eelgrass, *Zostera marina* L., a vital component of estuarine ecosystems, is presently experiencing a dramatic decline in estuarine environments resulting from both the wasting disease (caused by the pathogen *Labyrinthula zosterae*) and by human-related coastal pollution. Due to the extent of loss and the possibility of eelgrass beds being completely eliminated in some estuaries, human assistance in the reestablishment of these critical habitats is necessary. We hypothesized that eelgrass could be reestablished in areas of the Great Bay estuary, but that the light requirements of the plants would limit their subtidal range. Two sites with triplicate plots were transplanted with a tall and short form of eelgrass on a depth gradient of 0.5 m to 3.0 m depth at mean l o w water and monitored over a four month growing season. Measurements of density, patch area, canopy height, leaf width, and reproductive potential were taken every four weeks to monitor morphological and growth changes over time. Transplants established themselves, increasing in growth at both sites for four to six weeks before a moderate decline during the mid-summer. Dramatic losses of plants were observed in September, three weeks after Hurricane Bob radically altered water color and turbidity in the estuary.

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AQUACULTURE STRATEGIES EXPLOITING LIFE-HISTORY QUIRKS OF SEA SCALLOPS

Populations of sea scallops on the Atlantic coast exhibit both annual and biannual reproductive cycles depending on their geographical location (it's better in Nova Scotia). Populations with a n n u a l c y c l e s normally spawn in late summer (Aug.-Sept.) a n d c o l l ected spat can be grown to commercial size i n s u s p e n d e d culture in 33-36 months (90mm Sh, 15g meat). Populations with biannual reproductive cycles spawn both in early summer (June-July) and in fall (Sept.-Oct.). Spat collected from the early s p a w n i n g o f these precocious populations can be grown to market size in 24-26 months w h i l e the late s e t requires 36 months for grow-out. Use of early spawning populations for spat collection or hatchery production significantly reduces the grow-out period required for this species. Strategies exploiting both stock types would yield a steady supply of market-size scallops for the farmer especially if an assortment of end-products were desired (live scallops or roe-on scallops). YUM.

Farris, C. N. Marine Ecosystems Research Laboratory, Graduate School of Oceanography, Univ. of Rhode Island, Narragansett. RI, 02882. THE EFFECT OF TIDAL CYCLES ON THE EXCHANGE OF NUTRIENTS ACROSS THE SED1MENT-WATER INTERFACE WITH AN ESTUARY.

Many studies have investigated the variability of exchange rates of nutrients within different sites with-in an estuary. Relatively few have examined the influence of the variability in water characteristics that occurs throughout the course of a tidal cycle. My dissertation project will quantify the effect of differences in nutrient concentration, salinity and light levels over three hour intervals on the measured benthic flux rates in benthic microcosms. Preliminary experiments performed suggest significant changes in the benthic flux rates between different salinity regimes.

Franz, D.R. Biology Department, Brooklyn College CUNY, Brooklyn, NY 11210 (718)-780-5700
TEMPORAL PARTITIONING OF GROWTH IN RIBBED MUSSELS IN JAMAICA DAY

Growth rates of Geukensia demissa from a tall Spartina alterniflora marsh edge at one site in Jamaica Bay were analyzed on 6 dates between May and November, 1991. After cleaning, shell length and recent growth (growth added since the last growth line) were determined. Regressions of % increase vs initial shell length were used to estimate growth increments on each date for mussels over the available size range. Sexually immature mussels (<20 mm) maximize grow early in the summer. Medium mussels (40 mm) exhibit intermediate relative growth rates but do not partition growth. Large mussels (>70 mm) delay almost all growth until July and August. Immature mussels allocate all secondary production to growth. Intermediate mussels partition resources both to growth and reproduction. Delayed growth in larger mussels may be a strategy to maximize current reproduction.

George B. Gardner. Environmental Sciences Program University of Massachusetts/Boston, 100 Morrisey Blvd., Boston, MA 02125
SEASONAL EVOLUTION OF THE HYDROGRAPHIC STATE IN MASSACHUSETTS BAY FROM MARCH, 1990 TO JUNE, 1991: SUMMARY OF OBSERVATIONS DURING THE MASSACHUSETTS BAYS PROGRAM PHYSICAL OCEANOGRAPHY STUDY

Hydrographic observations including transmissometer and fluorometer (Chl-a)data, have been obtained in Massachusetts Bay as one component of a multi-institutional research project funded by the Massachusetts Bays Program. Six baywide survey cruises and four northern-bay cruises were conducted between March, 1990 and June, 1991. The seasonal evolution of the hydrographic conditions in the Bay is evident in this data. Beginning with well mixed conditions in the winter, salinity stratification is initiated, in March or April, due to spring runoff from the Merrimack River as well as rivers in Maine. During summer and early fall,the water column was strongly thermally Stratified, with less salinity variation than in the spring. Related variations in Chl-a concentrations will also be presented. Estimates of residence times within the Bay based on the hydrographic data will be discussed.

Anne E. Giblin, Charles Hopkinson, and Jane Tucker. The Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA, 02543 METABOLISM AND NUTRIENT CYCLING IN BOSTON HARBOR SEDIMENTS

We sampled four stations in Boston's Outer Harbor in September 1991. Sediment cores were brought back to the laboratory. Rates of oxygen uptake, and dissolved inorganic carbon, dissolved inorganic nitrogen and phosphate release were measured. Porewater profiles of dissolved inorganic nitrogen, phosphorous, alkalinity and sulfide were measured on separate cores. Sediment oxygen uptake ranged from 21.6 - 29.0 mmol m^{-2} d^{-1} for the four stations. Both total DIC fluxes and porewater profiles of alkalinity indicated that oxygen uptake was underestimating total respiration, although at most stations the underestimate was less than 20%. DIN fluxes ranged from 2.8 to 5.0 mmol N m^{-2} d^{-1}. We estimated denitrification using the ratio of total metabolism to dissolved nitrogen release. We calculate that from 0 to 3.35 mmol N m^{-2} d^{-1} 8 was denitrified at the four stations.

Goslee, Sarah C. and R. S. Warren. Botany Department, Connecticut College, New London, CT,06320 (203) 439-2132.

ENVIRONMENTAL FACTORS AND VEGETATION CHANGE ON THE WEQUETEQUOCK-PAWCATUCK TIDAL MARSHES, STONINGTON, CT.

Over four decades vegetation on much of the Wequetequock-Pawcatuck marsh complex has changed; stunted *Spartina alterniflora* and mixed forbs now cover large areas once dominated by *Spartina patens* and *Juncos gerardi* A number of environmental factors that could be causally related to these changes were followed at over 50 sites in eight different plant communities: vigorous and stressed *S. patens, J. gerardi* and *Triglochin maritime* which has replaced *J. gerardi along* the upper border, long-established, relatively recent and small patch stands of stunted *S.alterniflora,* and forbs. Factors included soil salinity, pH, sulfide, redox potential and water table depth as well as elevation and flooding regime. *S. patens* and *J. gerardi* had the lowest salinity and water table and highest redox. Changed areas of stressed *S. patens, T. maritima, S. alterniflora,* and forbs all had greater salinities, and lower redox potentials than the stable sites supporting vigorous *S. patens* and *J. gerardi.* Old stands of *S. alterniflora* had the most reduced peat and highest sulfide levels. We argue that the lower elevations and greater flooding in changed areas result in increasingly reduced peat, which is a key factor driving vegetation change on this system.

Hampson, George R. Biology Department, Woods Hole Oceanographic Institution, Woods Hole, MA. 02543 (508) 548-1400

A LONG HISTORY OF LEARNING THE HARD WAY: PLANNING BY CONSENT DECREE VS. COMMON SENSE

At the expense of the environment, coastal communities neglect to plan for ecologically sound development. Too often they are forced to try to undo what their neglect has created. Science and technology does not have all the answers to solve the many ills, yet management and the regulators expect a quick and definitive response with short notice especially when the courts take charge, as in the case of the Boston Harbor outfall.

HAUGEN, Elin M., Bigelow Laboratory for Ocean Sciences, McKown Point, West Boothbay Harbor, Maine 04575, (207)633-2173

PHYTOPLANKTON POPULATIONS IN MASSACHUSETTS BAY AND CAPE COD BAY: SPRING BLOOM 1991.

Phytoplankton samples were collected along 8-9 transects from Rockport to Sandwich, Mass in February, March and April of 1991. In Massachusetts Bay north of the Plymouth transect, the inshore phytoplankton community was always distinct from the offshore population as was described for the Boston transect in the spring of 1990. Although the cell constituents were similar in both Massachusetts and Cape Cod Bays, the dominant species developed 2-3 weeks earlier in Cape Cod Bay. Since offshore populations appear to enter the system at depth, water clarity and bottom topography influence the localization and dispersal of phytoplankton species.

Jury, Steven H. University of Massachusetts/NOAA Cooperative Marine Research Program, Amherst, MA, (413) 545-2842.

NOAA's Estuarine Living Marine Resources Program: Northeast Component.

NOAA's Estuarine Living Marine Resources (ELMR) program is a joint effort between the NOS' Strategic Environmental Assessments Division and the National Marine Fisheries Service. The objective of ELMR is to develop a consistent database on the distribution, abundance, and life history characteristics of important fishes and macro- invertebrates in the Nation's estuaries. The information presented is specific to 62 Northeast species found in 35 estuaries from Chesapeake Bay through Passamaquoddy Bay, ME; however these data are representative of the Nationwide data base. Species' spatial and temporal distributions and relative abundance levels are summarized from the micro-computer data base. A life history summary is developed for each species and focuses on species' biogeography, habitat associations, biological attributes, and reproduction strategies. This information is organized and shown in a series of life history tables to permit species assemblage analyses. The ELMR program provides managers with a uniform database to make comparisons among species, groups of species, specific life stages and times of year within an estuary or by geographic regions.

Kaldy, James E. Dept of Plant Biology and Jackson Estuarine Lab.; F.T. Short and D.M. Burdick, Dept of Natural Resources and JEL. University of New Hampshire, Durham, NH 03820. (603)862-2175

THE RESPONSE OF EELGRASS MORPHOLOGY TO LIGHT AND NUTRIENTS.

Eelgrass *(Zostera marina* L.) morphology has been extensively examined, but experiments generally have focused on only one environmental factor (water depth, light, nutrient pools, etc.). Using a series of mesocosms, the response of eelgrass morphology to the combined effects of reduced light (60% and 25% of full sunlight at the surface) and different rates of nutrient loading (reduced, ambient, and 12 times ambient) was assessed. Plants from 2 sources were collected and transplanted into the mesocosms. Pre-treatment morphology was characterized using a subset of the transplants. After six weeks, the plants were harvested to characterize post-treatment morphology. The data were analysed using a three way Anova model incorporating light, nutrients and plant source. Plants from one source maintained significantly higher shoot biomass ($P<.003$), rhizome biomass ($P<.03$) and leaf area ($P<.0001$). Morphological characteristics responded differently to light and nutrient treatments. Shoots ($P<.0001$) and rhizomes ($P<.004$) had lower biomasses at the lower light level. The number of leaves per shoot ($P<.03$) and shoot biomass ($P<.02$) showed decreases at 12 times ambient nutrient loading. Thus plant response to light and nutrient treatments varied with the parameter examined, while some pre-treatment differences between plant sources were retained.

Keay, Kenneth E.[1], M.J. Mickelson[1], C.M. Parmenter[2], and M.H. Bothner[2]
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2. U.S. Geological Survey, Woods Hole, MA. 02543 (508)548-8700.

Distribution of *Clostridium perfringens,* a sewage-indicating bacterium in the sediments of Boston Harbor and the Massachusetts Bays.

Clostridium perfringens is an anaerobic spore-forming bacterium commonly found in sewage and sewage sludge. Its spores are resistant to chlorination and persist in sediments, providing a useful long-term indicator of sewage accumulation in coastal marine sediments.

As part of our field surveys in Boston Harbor and the Massachusetts Bays, the MWRA and USGS have sampled sediments for *C. perfringens* at over 170 stations within-Boston Harbor, and at approximately 30 stations in the Massachusetts Bays. In surface sediments within Boston Harbor, *C. perfringens* counts are highest ($\sim 10^5$ spores/gdw) in depositional areas, particularly those adjacent to effluent and/or now-discontinued sludge outfalls. Elevated counts of *C. perfringens* in both the Harbor and the Bays persist to a depth of at least 20 cm below the sediment-water interface, probably a result of mixing by benthic organisms. *C. perfringens* counts within the Bays range from 10^4 spores/gdw near the mouth of the Harbor to 10^2 spores/gdw near the seaward limit of the Bays.

Kelley, Suzanne and W. A. Niering, Botany Department, Connecticut College, New London, CT 06320. (203) 439-4989.

ABOVE AND BELOW-GROUND PRODUCTIVITY OF HIGH MARSH PLANT COMMUNITIES ON THE WEQUETEQUOCK-PAWCATUCK TIDAL SALT MARSHES

Above and below ground productivity were estimated for the *Juncus gerardi,* stunted *Spartina alterniflora, Distichlis spicata, Spartina patens,* and forb communities on five marshes within the Barn Island Wildlife Management Area wetland complex in southeastern Connecticut. Productivity below ground was four to five times greater than above ground values for all species. Both above and below ground productivity was greatest in *J. gerardi;* (700/3400 g m^{-2} yr^{-1}) stunted *S. alterniflora, D. spicata, S. patens,* had intermediate values and the forb community was the least productive (170/885 g m^{-2} yr^{-1}). Within each species, there was no significant variation for above ground productivity between the five marshes. Within *J. gerardi* and *D. spicata,* however, there were significant differences in below ground production between marshes. These differences do not appear to be directly related to soil salinity, but do correlate with differences in flooding regime, soil water depth, redox potential, and pore water sulfide.

Kresl, J.M., T. Bradbury, H. Stebbins, and S. Yarish. Project Oceanology, Avery Point. Groton, CT 06340

TEMPORAL AND SPAT I.AL CHANGES OF HYPOXIC CO NDI T IONS IN THE THAMES RIVER ESTUARY

Low oxygen concentrations have been reported in the Thame's River Estuary particularly in the upper reaches for two decades. Measurements of dissolved oxygen, temperature, and salinity in the river taken throughout 1990 show a temporal variation in oxygen concentrations which is temperature dependent. Hypoxic condition persisted in the head of the estuary from June through December with the exception of October 14 when a high stream flow on feeder rivers pushed the hypoxia downstream 32 km. Hypoxic conditions returned within 3 weeks of the high flow event. Stratification, temperature, and the flow rate of feeder rivers appear to be the major three physical factors contributing to the temporal changes in oxygen concentrations at the head of the estuary.

LaMontagne, Michael, G. Smith[1] and J., Tiedje[2]. Boston University Marine Program, Woods Hole, Ma. 02543 (508) 548-3705 [1]New Mexico State University [2]Michigan State University

Application of DNA Hybridization to the Study of Denitrification

Until recently. the study of denitrification, and microbial processes in general, has been hindered by the difficulty in monitoring the microbes mediating the pathway of interest. We know very little about the relationship between populations of microbes and the flux associated with these guilds. To monitor denitrifiers, we have developed a DNA probe specific for the gene that codes for the enzyme nitrite reductase in *Pseudomonas stutzeri.* This probe was shown to be specific for denitrifiers. Preliminary evidence suggests that the intensity of the hybridization signal in DNA extracted from environmental samples is correlated to denitrifier activity. I propose to determine the relationship between denitrifier activity and populations in coastal marine sediments. To estimate denitrification rates, I will monitor the accumulation of N_2 in the overlying water of cores by using a novel technique to extract dissolved gas from seawater.

LARSEN, Peter F., Bigelow Laboratory for Ocean Sciences, McKown Point, West Boothbay Harbor, Maine 04575 and GAUDETTE, Henri E., Department of Earth Sciences, University of New Hampshire, Durham, N.H. 03824

TRACE METAL CONCENTRATIONS IN THE SEDIMENTS OF MID-COAST MAINE

In the summer of 1991, we measured trace metal concentrations at 35 stations between Portland Harbor and Linekin Bay to better define the sedimentary distribution of the metals, identify potential problem areas, and suggest sources and transport routes within the mid-coast Maine environment. The region sampled includes Casco Bay, the Kennebec and Sheepscot estuaries, and Boothbay Harbor. Fifteen of the Casco Bay stations were previously occupied in 1980. Sediment grab samples were dried and acid leached, and the leachate analyzed by ICP-AES for Cd, Cr, Cu, Pb, Zn, Sn and Ni.

The spatial and temporal distribution patterns of the various metals will be discussed and related to the region's natural and pollutional heterogeneity.

THE SEASONAL DISTRIBUTION OF NUTRIENTS IN MASSACHUSETTS BAYS

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The University of Massachusetts, Boston and the University of New Hampshire carried out detailed hydrographic surveys of the Massachusetts Bays system (including Boston Harbor, Massachusetts and Cape Cod Bays) as part of the larger study under the Massachusetts Bays Program. Hydrographic surveys were carried out during April, July, and October, 1990 and February, March, and April, 1991. The seasonal distribution of nutrients (nitrate+nitrite, ammonium, phosphate, and silicate) was determined and then used to make preliminary estimates of the relative importance of the different sources of nutrients to the Bays. The data suggest that phosphate and ammonium are supplied to the Massachusetts Bays area during spring mainly from Boston Harbor outfalls while nitrate+nitrite and silicate are brought in from around Cape Ann in the Gulf of Maine coastal plume. Our latest thoughts on nutrient distribution processes will also be presented.

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IN SEARCH OF A SANE APPROACH TO COASTAL EROSION PROTECTION MEASURES

Recent severe coastal storms, January 1987, December 1990, Halloween 1991, all caused erosion of both the barrier beaches protecting the Pleasant Ray and Nauset estuaries in Orleans, Ma. but also the coastal hanks that surround the bays. Development pressures and land values have resulted in houses built in erosion-prone areas leading to the desire of homeowners to protect their valuable land with "hard" structural solutions. While traditional research has concentrated on the effect of structures such as revetments on ocean-facing shorelines and has shown severe consequences of these structures on down-drift beaches, little work has focused on the effect of structures on the inland side of embayments. The local Conservation Commission has had numerous applications for various types of shoreline protection but has little in-formation on the effect of each proposed method on the physical/biological processes within embayments over time. The information presented in this forum is an overview of the problem to serve as a catalyst for discussion.

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SEAWEED RESPONSE TO NUTRIENT ENRICHMENT - A MESOCOSM EXPERIMENT

The response of three species of seaweed was measured during a nutrient addition experiment at our coastal lagoon mesocosm facility at the Graduate School of Oceanography. Additions were made to two replicate mesocosms each of ammonium plus phosphate (A+P), nitrate plus phosphate (N+P), nitrate alone (N), phosphate alone (P), and control (C) in loadings equivalent to 3.0 moles N m^{-2} y^{-1} and 0.25 moles P m^{-2} y^{-1} with an N:P ratio in the combined treatment mesocosms of 12:1.

The N+P and A+P combined nutrient treatments produced dense phytoplankton blooms which persisted throughout most of the experiment. In these mesocosms, seaweed biomasses remained low and growth measured in mesh cages under insitu conditions were low or negative. The Control and P treatments remained very clear throughout the summer and produced much higher biomasses of seaweeds dominated by Cladophora sp. The nitrate (N) treatment mesocosms, which were characterized by mid-summer phytoplankton blooms, showed an initial response of Ulva growth in early spring and a late response of Gracilaria and Cladophora in early fall, but had little seaweed biomass coincident with the phytoplankton blooms. To determine the degree which low light levels were limiting seaweed growth during phytoplankton blooms, seaweeds were incubated both near the surface and near the bottom in mesh growth chambers. Growth rates near the surface were significantly higher than bottom growth rates in October, but not in June. A combination of light levels, available nutrients, and perhaps, grazing pressure are involved in controlling seaweed responses to nutrient loading.

Moore, Johnes K. and Cindy DelPapa. Bio.Dept. Salem State College, Salem, MA 01970 and Massachusetts Audubon: North Shore, 346 Grapevine Rd. Wenham, MA 01984.

TIDE GATES, POCKET MARSHES, AND THE MYTH OF WETLAND PROTECTION

There is a contentious set of tide gates at the mouth of the Forest River estuary on the border between Salem and Marblehead, MA. While these gates have operated sporadically for over 55 years, only recently has there been any visible effect to the adjacent marsh. We discuss the curious sociology and management practices associated with gate operation.Data on salinity, temperature, and DO (gates open vs gates closed) gathered in the summer of 1991 reveal a potentially detrimental condition which, while intuitively obvious, is nonetheless rather interesting. Suitable for viewing by children.

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RIBBED MUSSEL (GEUKENSIA DEMISSA) RECRUITMENT IN JAMAICA BAY, NY

Juvenile mussel (Geukensia demissa) recruitment to a Spartina alterniflora marsh was examined in the Jamaica Bay Wildlife Refuge (NYC). A field study was conducted using flower pots with two experimental substrata, marsh sediment or adult living mussels.The pots were placed into the marsh surface at three shore levels within the tall Spartina zone. These were retrieved and replaced biweekly, from July through November 1991, in order to determine primary settlement preferences and the time of peak recruitment. Peak recruitment of mussels in the smallest size range (0.5-5.0 mm) occurred along the marsh edge from September through October. Mussels in the larger size ranges (5.0-15 mm) were recorded moving into pots only in July. These most likely represent the 1990 cohort. Recruitment at all levels and times was greater in containers with adult mussels by a factor of approximately 5.

Peck, M. A. and P. E. Fell, Zoology Department, Connecticut College, New London, CT 06320 (203) 439-2132.
RESTORATION OF INVERTEBRATE POPULATIONS ON AN IMPOUNDED MARSH OF THE WEQUETEQUOCK-PAWCATUCK TIDAL MARSH SYSTEM FOLLOWING RE-INTRODUCTION OF TIDAL FLUSHING.

This study assesses the restoration of an impounded marsh by comparing macroinvertebrate populations in different low and high marsh areas at the Barn Island Wildlife Management Area, Stonington, CT. In high marsh areas attention was focused on *Melampus bidentatus* (Say), the coffee bean snail. In low marsh areas effort was focused on *Gukensia demissa (D.),* the ribbed mussel, and on *Uca* spp, fiddler crabs. Animal populations in the two regions were similar, indicating successful restoration. However, there are differences in snail density and biomass between the impounded and unimpounded marsh regions. Also, within each region, the population size of *Melampus* varies significantly in relation to vegetation and elevation. Mussel and fiddler crab populations in the impounded region were comparable to those found in similar, unimpounded sites.

Pregnall, Marshall. Biology Department, Vassar College, Poughkeepsie, NY 12601
GROUNDWATER INPUT OF NITRATE IN BUZZARDS BAY, MA RELATED TO HUMAN POPULATION DENSITY: EFFECTS ON MACROPHYTE NITRATE REDUCTASE.

Three coves on the eastern side of Buzzards Bay, MA that represent a gradient of human population density were studied to determine the input of nitrate via groundwater percolation and subsequent effects on macrophyte nitrate reductase activity. Kettle Cove on Naushon Island, and Quissett Harbor and Megansett Harbor on Cape Cod were sampled seasonally for groundwater flow, pore-water nutrient content, nearshore nutrient content, and macrophyte nitrate reductase activity. All sites exhibited quite variable nitrate flux and groundwater flow rates. Except for winter the Kettle Cove beach sediments had the lowest nitrate flux rates of the three sites and usually took up nitrate from the water column. Megansett Harbor beach sediments exhibited the highest efflux of nitrate except for winter, and Quissett Harbor sediments either had no net flux of nitrate (in winter and spring) or lower efflux rates than Megansett Harbor. Pore-water nitrate maxima usually occurred at the landward end of beach transects, suggesting that groundwater flow contributed the majority of nitrate to flux. Hurricane Bob depleted beach sediments of nitrate, presumably by massive flushing. Macroalgae collected close to the shoreline had elevated nitrate reductase activity at Quisset Harbor and Megansett Harbor relative to Kettle Cove; the response of eelgrass was less distinct.

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VERTICAL WATER COLUMN STRATIFICATION AND SPRING PHYTOPLANKTON BLOOMS IN THE GULF OF MAINE

Several studies have shown that the initiation of phytoplankton blooms in temperate coastal waters can begin in late winter at a time of increasing solar elevation and during periods of cloud-free weather. It appears that net photosynthesis will exceed respiratory losses when the vertically-integrated *in situ* light intensity reaches ca. 40 Ly d^{-1}. Depending on water clarity, this may occur in coastal waters in the absence of vertical stratification, where the bottom serves as the base of the mixed layer. The classical Sverdrup model of spring phytoplankton blooms in offshore waters holds that the bloom will commence only upon the onset of vernal warming and thermal stratification, such that the depth of the upper mixed layer is shallower that the critical depth. Cruise results over the past two years will be presented which suggest that a pycnocline is not required at all times for a bloom to begin, provided that wind mixing of the upper water column is relaxed. Consequently, the thermocline may develop as a result of light scattering by the increased cell densities in the surface waters.

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THE SEASONAL RELATIONSHIP BETWEEN DISSOLVED INORGANIC NITROGEN AND HYPOXIA IN THE THAMES RIVER ESTUARY

Ammonium and nitrate concentrations varied temporally and spatially in the estuary. High (30uM) ammonium concentrations were correlated to low (3 ppm) dissolved oxygen concentrations and salinities 15 ppt particularly at the head of the estuary. Nitrate concentrations were variable with no significant relationship between nitrate and dissolved oxygen. Variability in nitrate concentrations were attributed to input from a wastewater treatment plant and runoff from feeder rivers that drain agricultural land. Sediment porewater ammonium concentrations increased upriver and were up to 100 times greater then overlying water concentrations at the head of the estuary. Sediments appear to be the major source of ammonium to the bottom water. Input of organic matter from anthropogenic sources and strong vertical stratification may combine to produce conditions that consume oxygen and produce ammonium.