

New England Estuarine Research Society



**ABSTRACTS
FALL 1996 NEERS MEETING
AND "NORTH CAPE OIL SPILL: LESSONS LEARNED"
BLOCK ISLAND, RI
OCTOBER 24-26, 1996**

JOINTLY HOSTED

BY

**THE GRADUATE SCHOOL OF OCEANOGRAPHY
UNIVERSITY OF RHODE ISLAND**

i41VD

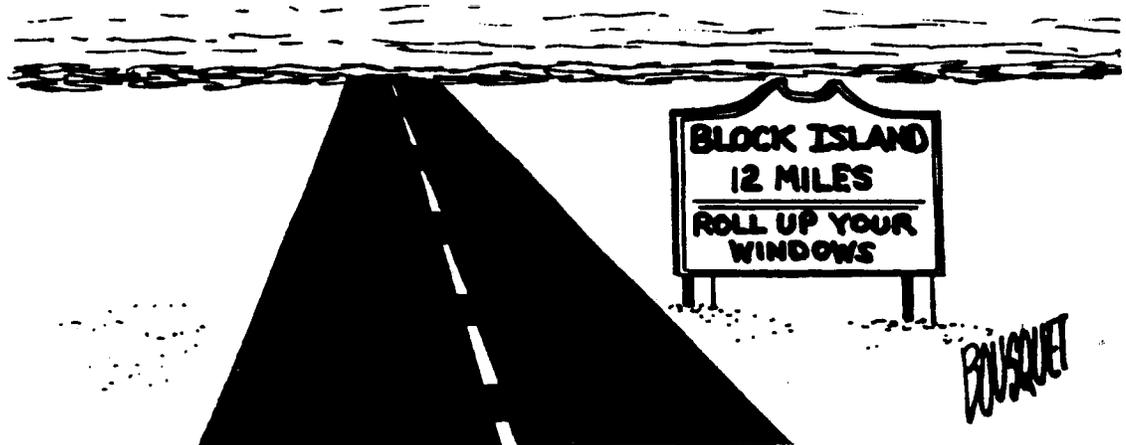
**US ENVIRONMENTAL PROTECTION AGENCY, NHEERL,
ATLANTIC ECOLOGY DIVISION, NARRAGANSETT**

AND

RHODE ISLAND SEA GRANT

AND

**USDOC, NOAA, NATIONAL MARINE FISHERIES SERVICE,
NORTHEAST FISHERIES SCIENCE CENTER**



Altwater, L. D., A. C. Orsted, M. J. Santo, D. R. Warren, S. J. Weissback, R. S. Warren and W. A. Niering. Connecticut College, New London, CT 06320.

PATTERNS OF VEGETATION AND MACROINVERTEBRATE POPULATION RECOVERY ON EIGHT CONNECTICUT TIDAL MARSHES FOLLOWING RESTORATION OF TIDAL FLOODING: PRELIMINARY FINDINGS.

The objective of this study was to determine patterns and rates of restoration for tidal marsh vegetation and macroinvertebrate populations with the reintroduction of tidal flooding to eight marshes distributed along *ca.* 100km of the Connecticut coast. Effects of four environmental variables were considered: flooding frequency, salinity, water table, and years (1 to 10) since tidal restoration. Marshes were sampled using three 30 - 50m transects with wells at 3m, 10m, and 30m; control lines were set in the three systems with contiguous unrestricted marsh. Elevation and vegetation were taken at one m intervals along each transect. Salinity and water table were measured bi-weekly. Macroinvertebrates were sampled quantitatively at each well. Rates of vegetation recovery were followed using '74, '81, '86, '90, and '95 air photos, scale normalized using GIS. Vegetation recovery was most rapid, *ca.* 13% yr.⁻¹, at the high salinity ($\pm 30\text{‰}$) site with greatest flooding frequency and slowest, *ca.* 2.5% yr.⁻¹, on low salinity ($\pm 5 - 15\text{‰}$), low flooding frequently marshes. Invertebrates re-established rapidly, but in all cases at population densities lower than found on control areas that had not been subjected to tidal restriction.

Arnofsky, P. and E. Ruber. Department of Biology, Woods Hole Oceanographic Institution, Woods Hole, MA 02543 and Biology Department, Northeastern University, Boston, MA 02115.

USE OF PRINCIPAL COMPONENTS ANALYSIS TO EVALUATE MORPHOLOGICAL VARIATION IN THE GENUS *APOCYCLOPS*.

The genus *Apocyclops* is a salt marsh copepod inhabiting standing pools of saline water. Three populations of *A. spartinus* and two populations of *A. panamensis* were shown to have high intraspecific morphological variation. Principal components analysis (PCA) was used to determine whether combined morphological characters would permit separation of different species while retaining groupings of populations within species. Ten analyses of seven populations, including two east and two west coast species, were conducted. Results show that despite high intraspecific variation, each species separates into its own graphic space.

Bintz, J. C., and S. W. Nixon, S. L. Granger, B. A. Buckley, S. Sherwood. University of Rhode Island Graduate School of Oceanography, South Ferry Road, Narragansett, RI 02882.

TOP DOWN CONTROLS ON THE ENRICHMENT RESPONSE OF A COASTAL MARINE ECOSYSTEM: A MESOCOSM EXPERIMENT

Results of past mesocosm experiments have clearly demonstrated that "bottom-up" effects are important in lagoonal seagrass beds. Nutrient enrichment can cause elevated phytoplankton populations, macroalgal blooms, high epiphytic growth and subsequently decreases in seagrass biomass. This research is intended to determine the extent to which grazers in the system can exert "top-down" control, and quantitatively alter the responses of phytoplankton, epiphytes and macroalgae to nutrient enrichment of shallow lagoon ecosystems. Preliminary data indicate that filter feeding bivalves have the potential to substantially increase water clarity by decreasing the potential for phytoplankton blooms. Epiphytes and macroalgae which compete with eelgrass for both light and nutrients may also show a decrease in biomass due to isopod grazing pressure.

Brawley, A.H., R.S. Warren and R.A. Askins, Connecticut College, New London, CT 06320.
BIRD USE OF RESTORATION AND REFERENCE MARSHES WITHIN THE BARN ISLAND
TIDAL WETLAND COMPLEX, STONINGTON, CONNECTICUT.

Active management for tidal marsh restoration in Connecticut has been ongoing for nearly twenty years, but most project evaluations have only included observations of vegetation change. A formerly impounded marsh at the Barn Island Wildlife Management Area is a notable exception; previous research at this site has also included assessments of primary productivity, macroinvertebrates, and use by fishes. Here we report on the effects of marsh restoration on higher trophic levels. We monitored bird populations at five sites at Barn Island, including restoration and reference marshes. Use by breeding and migrating bird populations within fixed plots at all sites was recorded over two years. Our principal focus was on site IP-1, a previously impounded marsh re-opened to tidal inundation *ca.* 1980. IP-1 supported the greatest abundance and diversity of saltmarsh birds, indicating that it is at least equivalent to reference marshes within the system for this ecological function. A second site, under restoration for four years, appears to be developing in a similar fashion. It is clear that returning tidal action can, over time, restore a suite of ecological functions to tidal marshes.

Brush, M. J., S. W. Nixon, and S. L. Granger, Graduate School of Oceanography,
University of Rhode Island, Narragansett, RI 02882.

PRODUCTION AND RESPIRATION RATES OF TWO MARINE MACROALGAE.

Production rates of *Ulva lactuca* and *Gracilaria tikvahiae* collected from Greenwich Bay, RI were measured by incubating samples in polycarbonate chambers at field temperatures, ambient nutrient concentrations, and various light levels. Respiration rates were measured by incubating both algae in the dark. Since *Ulva* has been observed to accumulate in layers, it was incubated in 1, 2, 4, and 8 layers in all experiments. P-I curves for *Ulva* and *Gracilaria* showed the typical hyperbolic response, and layering of *Ulva* led to reduced production per unit weight, presumably due to shading. Layering also reduced respiration rates, presumably due to limited oxygen diffusion through the spaces between layers. Respiration rates of both algae also decreased over time as oxygen concentrations decreased. Furthermore, extinction coefficients were measured through *Ulva* thalli and *Gracilaria* mats, and results were regressed against chlorophyll content for *Ulva* and dry weight for *Gracilaria*. These experiments will be used to calibrate an ecosystem-level model of Greenwich Bay, in which *Ulva* and *Gracilaria* have been found to be the dominant macroalgae.

Burdick, David M., Pamela A. Morgan and Frederick T. Short, Department of Natural Resources
University of New Hampshire, Jackson Estuarine Laboratory, Durham, NH 03824.
EVALUATING A SALT MARSH CREATION IN NORTHERN NEW ENGLAND

Creation of salt marsh habitat in northern New England presents special problems, particularly the slow rate of marsh development and the physical stress of ice scour on new transplants. Creation techniques are well established along most of the Atlantic coast, especially for low marsh, but the number of marsh creation projects and their success rate are both low north of Massachusetts. As mitigation for a 0.3 ha area of marsh destroyed by the expansion of the Port of New Hampshire, a 0.4 ha area of degraded intertidal flats in a protected tidal pond was filled with silty sand to elevations similar to nearby salt marsh. Drainage channels were constructed to divide the area into eight "lobes" that were planted in June 1993 with shoots of locally-collected *Spartina alterniflora* at a density of 9 per m². By the fall of 1995: 1) overall plant biomass and % cover were increasing, but were not equivalent to reference marshes; 2) transplanted vegetation had been lost from the outer edges of the marsh; and 3) the highest areas of some lobes had lost plant density. Our assessment indicates that more time is required for development of the marsh vegetation in northern New England than for more southerly projects. And even in sheltered locations, the physical stress of ice scour can limit success.

Chambers, R.M. and J.C. Ambrose, Biology Department, Fairfield University, Fairfield, CT 06430. POSSIBLE MECHANISM FOR CONTROL OF *PHRAGMITES* GROWTH IN TIDAL WETLANDS.

The effects of flooding and saltwater on nutrient availability to *Phragmites* were determined by examining nitrogen uptake as a function of rhizosphere conditions in greenhouse plants. Initial ammonium uptake rates at 0‰ (42 μ moles N/g root/h) were nearly double those at 10‰, and 3-4 times greater than rates at 20 and 30‰. At high salinities, reductions in ammonium uptake lead to stunted plant growth. Uptake rates at all salinities, however, were higher than rates reported for *Spartina alterniflora*. Nitrogen uptake was reduced dramatically when rhizosphere oxygen was kept at 0 mg/L and when sulfide was present. These results indicate that reduction in nitrogen uptake by both flooding and saltwater may be the mechanism by which 1) *Phragmites* is kept from expanding into low marsh elevations, and 2) *Phragmites* is eventually removed from wetlands re-opened to tidal flooding.

Chandler, Mark, New England Aquarium, Central Wharf, Boston, MA; Phil Colarusso, U.S. EPA, Boston, MA; and Robert Buchsbaum, Massachusetts Audubon Society, Wenham, MA
DIFFERENCES IN FISH COMMUNITIES AMONG NEARSHORE HABITATS IN BOSTON HARBOR AND NORTHERN MASSACHUSETTS BAY

The general consensus that vegetated near-shore habitats such as eelgrass meadows are a significant fish habitat is based primarily on studies done in the Mid-Atlantic. We compared the fish species present in four small eelgrass beds and nearby unvegetated areas in Massachusetts using gill nets and minnow traps from 1993 to 1995. These surveys were complimented by beach seines and diver transects. Stomach content and carbon and nitrogen stable isotope analysis was completed on several fish to understand the food web structure associated with these habitats. Juveniles (age 1+) of commercially important species, primarily pollock (but also cod and hake) were more frequently caught in eelgrass than in nearby unvegetated sites. A one year sampling of a macroalgal vegetated site suggests that not all vegetated habitats are of equal value to fishes. Analysis of stomach contents of large pelagic fish caught in eelgrass indicated that most of the individuals contained invertebrates or small fish that are predominantly found in eelgrass. The results from this study confirm that not all near shore habitats are of equal value to fishes, and that even small eelgrass beds function as important fish habitat in Massachusetts Bays.

Clancy, M. and J.S. Cobb. Department of Biological Sciences. University of Rhode Island, Kingston R.I. 02881. EFFECTS OF THE NORTH CAPE OIL SPILL ON THE JUVENILE LOBSTER POPULATION.

The North Cape oil spill severely impacted the juvenile lobster population, with lobsters being washed up on beaches in significant quantities for several days after the spill. To evaluate the consequences of this impact on the lobster population we undertook an ambitious diving program, using both visual surveys and benthic airlift sampling. At the end of this study, we will base our conclusions on three sets of observations taken during winter (February-April 1996), summer (mid-July), and Fall (mid-September). Although lobster density was low and variable during our winter survey, we detected significant differences using both visual and airlift techniques when we compared control and impacted areas: visual ($F_{3, 0.03}=6.07$; $p=0.009$) and airlift ($F_{6, 0.03}=6.03$; $p=0.0001$). Our summer survey indicated higher average densities, with higher variability than winter; lobster density remained significantly higher in control areas using visual survey ($F_{2, 0.05}=9.44$; $p<0.0001$) while a non-significant trend of higher densities in control areas ($F_{2, 0.05}=2.57$; $p<0.0787$) was present using the airlift.

Crawford, R.E. Waquoit Bay National Estuarine Research Reserve, P.O. Box 3092, Waquoit, MA 02536. A STUDY OF THE BIOLOGICAL AND PHYSICAL EFFECTS OF BOATING IN A SHALLOW COASTAL EMBAYMENT

Habitat alteration and degradation are of prime concern in coastal waters. An obvious cause of this change is the physical alteration associated with boating. While it is plainly obvious that sediments are disturbed by propeller wash, it has proven difficult to devise management schemes that successfully minimize this phenomenon. This task is made more difficult because there are no established relations between boating, sedimentation, benthic productivity, light attenuation, and the physiological requirements of submerged aquatic vegetation and benthic fauna. A cause and effect relation for impacts associated with boating in shallow areas would be a valuable tool for resource managers. This report presents initial findings of a study underway at the Waquoit Bay National Estuarine Research Reserve to determine the change in sediment load, turbidity and light attenuation caused by the operation of boats of various horsepower in the main navigation channel of a shallow embayment and in shallow docking areas. These observations are coupled with measurements of parameters such as water depth, wind speed and wind direction. The study also includes direct examination of propeller wash disturbance on the benthos and sediments.

Davis, Ryan and Frederick T. Short. Jackson Estuarine Laboratory, University of New Hampshire, Durham, NH. QUANTIFYING THE EFFECTS OF BIOTURBATION BY GREEN CRABS (*Carcinus maenas*) ON EELGRASS (*Zostera marina*, L). TRANSPLANTS USING MESOCOSM EXPERIMENTS

We recently completed a 2.63 hectare eelgrass transplanting project in the Great Bay Estuary, New Hampshire. The project was successful, but transplant survival was reduced at several subtidal sites by bioturbating organisms, principally green crabs (*Carcinus maenas*) and clamworms (*Neanthes virens*). Green crabs were found to clip off transplanted eelgrass shoots to an extent that some transplant sites had greatly reduced success. We conducted a series of mesocosm experiments in July and August, 1996 to quantify the effect of green crab bioturbation on eelgrass transplants. Each of eight replicate 1.36 m² mesocosm tanks was transplanted with eighteen planting wils (36 shoots) of eelgrass and allowed to stabilize for one week. For each of three experiments, tanks were assigned either a low (0 or 1), moderate (5), or high crab density (10, or 20). The mean number of shoots cut was determined and used as a surrogate for transplant survival.

Transplant survival was not significantly different ($p=0.9231$) among the two highest crab density treatments (10 and 20 crabs); nor were they significantly different ($p=0.3278$) between a low density (1 crab) and high density (10 crabs) treatment. However, significantly more shoots were cut in the tanks with five crabs than with any other density ($p=0.0089$). The results demonstrate that green crabs have a significant effect on transplant survival at moderate densities, but there appears to be a threshold above which bioturbation does not increase with increasing crab density. These results demonstrate that biological site characteristics can influence transplant survival and should be incorporated in any site selection model.

DeLeo, W, C. Kincaid and R. Pockalny, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI 02992. PATTERNS IN NARRAGANSETT BAY CIRCULATION: CONSTRAINTS FROM A SHALLOW WATER ACOUSTIC DOPPLER CURRENT PROFILER

Estuarine circulation is driven by a combination of factors including tides, wind, runoff and gravitational flow. Previous work using moored current meters suggests Narragansett Bay (NB) forcing is dominated by tides and wind. Modeling studies (Spaulding and others) have also suggested that patterns in NB circulation vary dramatically depending on whether flow is dominantly driven by the tides or by the wind. To further quantify differences in wind versus tidal flow, we utilize a ship-mounted, shallow water, Acoustic Doppler Current Profiler (ADCP) to characterize both circulation patterns within NB and volume fluxes between regions of the Bay. Results are presented from ongoing studies of circulation in regions characterized by relatively small, intermediate and large spatial scales. Field study areas include Coddington Cove, Coasters Harbor, Mt. Hope Bay and lower NB. One important observation is that at intermediate and small scales, we find a pattern of tidally driven exchange with greater NB which exhibits a laterally structured (vertically homogeneous) flow over a significant portion of the tidal cycle. During wind events, however, this pattern of exchange may evolve into one of vertically stratified inflow and outflow. Results are also presented from ADCP surveys and water sampling conducted during the North Cape oil spill which highlight prevailing current patterns in Block Island Sound and estimate contaminant fluxes into Point Judith Pond.

Dow, D.B., G.W. Loomis, Department of Natural Resources Science, University of Rhode Island, Kingston, RI 02881.

URI Cooperative Extension On-Site Wastewater Training Center: Training and Technologies to Reduce Nitrogen Loading to Coastal Waters.

Based on nutrient loading models of sensitive and critical resource areas, innovative on-site wastewater technologies can be deployed to help control and limit the amount of nutrients entering those areas. This presentation shows how the Training Center works in conjunction with other members of the Cooperative Extension Water Quality Group to provide communities with the necessary tools to utilize and maintain innovative on-site technologies to reduce and control nutrient impacts. Municipal training, technical support and public education are all essential for developing wastewater management programs that ensure long term performance of innovative as well as conventional technologies. The presentation will be based on work done with the Town of New Shoreham, Block Island. This presentation should be done in conjunction and following the presentation on municipal training and nutrient loading model submitted by Lorraine Joubert.

DuPont, Henry and Crowley; Michele, The Committee for the Great Salt Pond, PO Box 1092, Block Island, RI 02807, (401) 466-5061, [www.ultranet.com/block island/saltpond](http://www.ultranet.com/block%20island/saltpond). THE COMMITTEE FOR THE GREAT SALT POND.

The Committee for the Great Salt Pond was founded a decade ago in response to the threat of a proposed commercial ferry terminal in New Harbor. Through grass roots organization and fund raising, the opposition to this project became more defined and not only was the proposed ferry terminal defeated, but Block Island's leading environmental protection organization was born. The Committee's basic action plan defines our role as follows: to help protect and enhance the environmental quality of the Great Salt Pond, including its shorelines and wetlands, and to promote appropriate and productive uses of the Pond's resources by residents, visitors and local businesses. Committee representatives will be on hand to discuss our role in responding to last year's North Cape Oil Spill, as well as explaining our role in developing new programs which represent productive and non-threatening uses of the Great Salt Pond. The Committee will offer a poster presentation highlighting our various activities, oil spill text and photos, as well as information and maps related to the Great Salt Pond.

Epstein, Slava S. and Ernest Ruber. Marine Science Center and Biology Department Northeastern University, Boston, MA 02115.

DISTRIBUTION OF NORTH SEA MEIOBENTHOS ALONG AN EXPERIMENTALLY ESTABLISHED OXYGEN GRADIENT

We investigated the vertical distribution of meiobenthos in response to experimentally induced oxygen gradients in an intertidal North Sea sediment. Earlier studies (which we summarize) dealt with ciliate distributions. Our present results deal with copepod (and possibly nematode) responses to these oxygen gradients.

D.R. Franz, Biology Department, Brooklyn College CUNY, Brooklyn, NY 11210
RIBBED MUSSEL DENSITY, RECRUITMENT AND PRODUCTION IN JAMAICA BAY

In Jamaica Bay, dense aggregations of mussels occur in a ~1 meter band along the lower marsh edge. A population sampled in the Fall, 1991 through 1995, averaged 18,000 per m² of which ~67% were 0-class mussels (recruits.) Variability in recruitment is related to the frequency and timing of summer recruitment. By November of each year the population consists of recruits plus 7 older year classes. Age structure stability probably is maintained by high over-winter mortality of 0-class mussels. A preliminary estimate of population production in 1995 is presented based on shell and body growth data from 1994 (an average year): Production was highest in 2-yr mussels. For the population as a whole, half of total production is reproductive output. Estimated total production per m² was 1700 g dry tissue weight, higher than most reef bivalve populations but within the reported high-end range for mussels. The ratio of annual production to mean biomass declines with shell length, and drops below 1.0 in mussels > 40 mm. High production in this population reflects an age structure skewed toward young, sexually-mature but rapidly-growing mussels.

Haebler, Romona & Doranne Borsay, NHEERL/AED, 27 Tarzwell Dr., Narragansett, RI 02882. CRY OF THE LOON: THE NORTH CAPE OIL SPILL.

On January 19, 1996, the North Cape Barge ran aground on Moonstone Beach in Southern Rhode Island spilling 800,000 gallons of #2 fuel oil. Catastrophic events involving the release of oil into the marine environment are known to cause adverse effects on exposed wildlife. The risk to wildlife associated with any given spill varies and is determined by several factors, including type and quantity of oil, climatic and environmental conditions, and specific physiological characteristics and habitat requirements of the exposed species. Several hundred sea birds overwintering in near shore waters were exposed to the chemicals in this highly refined oil. Efforts were made to collect all exposed birds, both dead and alive. One hundred fourteen birds were captured alive and treated at a rehabilitation center. The majority of these live birds were Common Loon, *Gavia immer*. Gross necropsy and histopathology examinations were performed on all animals that died in captivity. This presentation will discuss the natural history of loons, review the literature regarding known effects of petroleum hydrocarbons in exposed birds, compare some aspects of this spill to the Exxon Valdez crude oil spill, and discuss how pathological examinations will be used to improve our understanding of the Common Loon.

Matthew P. Harrington, Ass't Professor of Law, Marine Affairs Institute, Roger Williams University School of Law, 10 Metacom Avenue, Bristol, RI 02809. (401) 254-4614
CLARIFYING *THE SHIPOWNER'S LIABILITY* FOR OIL SPILLS

Passed in the wake of the EXXON VALDEZ oil spill, the Oil Pollution Act of 1990 was thought to provide an efficient and reliable statutory means by which parties injured by damage from oil spills might be quickly compensated for losses. The Act imposes strict liability on polluters, requiring them to take immediate action to mitigate the effects of a spill and demonstrate a level of financial responsibility sufficient to meet potential claims. Contrary to popular belief, however, OPA does not make a vessel owner strictly liable for all damages. It does not provide for unlimited liability. Absent gross negligence, OPA permits an owner to limit liability for oil pollution damage to \$10 million for all damage resulting from a spill. Where non-OPA damages are at issue, the Shipowner's Limitation of Liability Act of 1851, remains available to limit the liability of a vessel owner to the value of the vessel involved. Thus, in the case of the NORTH CAPE oil spill, the barge owners' liability is potentially subject to a limit of \$10 million for OPA damages and the sum of \$15,500 for claims brought under state environmental laws. The contradictions inherent in the relationship between OPA and the Limitation Act are brought into bold relief by the NORTH CAPE oil spill. At present, there is a great deal of confusion concerning the extent to which OPA has implicitly repealed the provisions of the Limitation Act as well as the injustice of permitting perpetrators of large-scale environmental damage to escape a substantial portion of liability for damage. This paper will discuss the current contradictions in the statutory scheme and advance a rather modest plan by which the difficulties inherent in OPA and the Limitation Act might be corrected.

Hinga, K.R., Graduate School of Oceanography, University of Rhode Island,
Narragansett RI 02882.

pH VARIABILITY IN COASTAL WATERS AND pH EFFECTS ON MARINE
PHYTOPLANKTON

The pH in typical coastal environments may vary 1 to 2 pH units. This range is great enough, relative to the observed effects of pH on the growth of marine phytoplankton, that seawater pH should be a factor in the ecology of coastal marine phytoplankton. Different species have maxima in growth rate ranging from pH 6.3 to 9.3. The effects of pH do not appear to be limited to extreme pH conditions. The growth rates of many species are influenced significantly by changes in pH near the normal pH of coastal seawaters.

Holt, E. and R. Buchsbaum, Massachusetts Audubon Society, Wenham, MA 01984. BIRD
USAGE OF *PHRAGMITES AUSTRALIS* IN THE PLUM ISLAND SOUND REGION,
MASSACHUSETTS.

Considerable attention and some resources have been focused on the impact and control of the invasive reed *Phragmites australis*. However little documentary evidence has been published on the effects of *Phragmites* on wildlife in salt marshes. With support from the Oak Knoll Foundation of Rowley, MA, we have begun to carry out quantitative bird censuses in *Phragmite* and adjacent habitats as part of a long-term study of the impact of *Phragmites* in the Plum Island Sound region. Census techniques have included visual observation, passive listening and playback techniques from point count circles and platforms. Preliminary results indicate considerable, but highly clumped, post breeding usage by Common Grackles, Redwing Blackbirds, and Tree Swallows, apparently for roosting. Common Yellow Throats and Song Sparrows also regularly occur in *Phragmites*. Marsh Wrens, have been observed predominately in *Phragmites*, and individual Marsh Wrens have not been observed leaving patches in which they were detected.

Jadamec, J. Richard and Paul deFur, Mike Kovacs, Carol P. Anderson, The
University of Connecticut Marine Sciences and Technology Center, Coastal
Environmental Laboratory, 1084 Shennecossett Road, Groton, CT 06340

SPILL SITE ANALYSIS OF THE NORTH CAPE OIL SPILL BY FLUORESCENCE
SPECTROSCOPY

The high winds and rough seas after the grounding of the North Cape caused the oil to disperse within the water column and enter the bottom sediments. The cold weather lessened evaporation of the light oil and a significant portion of the oil was "lost" within the water column. Environmental assessment studies in the aftermath of the spill was concentrated in nearby coastal salt ponds and near the surface slick, which was driven south and eastward from the site of the spill. Our laboratory determined if the spilled oil had migrated toward Long Island Sound waters. Surface, subsurface and bottom water samples were collected from ten stations. These samples were analyzed on board ship by fluorescence spectroscopy. The fluorescence spectra readily showed that discharged oil was present. The collected samples were returned to the laboratory for confirmation of the presence of oil by GC/MS analysis and for additional studies on the behavior of this oil within the water column. Simulated outdoor weathering studies showed that the No. 2 fuel oil weathered differently on the surface than in the water column. Our studies demonstrate that the effects of a large oil spill are not necessarily confined to the area immediately surrounding the spill and the movement of the surface slick. Future monitoring efforts should consider the possibility that subsurface circulation may distribute dissolved components counter to the surface spill.

Jaworski, C.L. and E. Gibbs, Rhode Island Sea Grant, University of Rhode Island, Narragansett, RI 02882-1197. COMMUNICATING OIL SPILL INFORMATION: THE RHODE ISLAND SEA GRANT NORTH CAPE WORLD WIDE WEB PAGE.

Rhode Island Sea Grant first appeared on the World Wide Web on January 24 in reaction to the North Cape oil spill. The oil spill page featured news reports on the spill, a link to AP wire service reports, media contacts, information on Sea Grant and university oil spill research, scientist's comments, and links to other oil spill-related web sites. The Sea Grant oil spill site received more than 3,000 hits, or visits, during the month of January, as people from around the country (as shown by e-mail correspondence) checked for updates of the spill. The appearance of the web site also spurred the Providence Journal-Bulletin to make its articles and photographs on the spill available on the World Wide Web. The Sea Grant webpage continues to be a source of oil spill information with links to other significant oil spill sites.

N. A. Jaworski, Senior Research Scientist, 202 Wordens Pond Road, Wakefield, RI 02879

Estimates of Nitrogen Fluxes from Various External Sources to Buzzards, Narragansett, and Peconic Bays during the Past Century.

Currently, there are fairly reasonable estimates of the total nitrogen fluxes to most estuaries of the middle Atlantic and Northeast USA. The major external sources of nitrogen are wastewater discharges, agriculture runoff and atmospheric deposition. Our ability to quantify the riverine flux contributions from each of the three sources and how the sources have increased over the past century remains poorly characterized.

In my presentation, I will offer a simple model, in spreadsheet format, that can be used to estimate the nitrogen fluxes from the three sources. The estimates are based on current fluxes and with historical population, NO_x emissions, and fertilizer use data. Estimates of total nitrogen fluxes from 1900 to 1994 for Buzzards, Narragansett, and Peconic Bays are presented.

Jaubert, L., D. Q. Kellogg, and A. J. Gold, Department of Natural Resources Science, University of Rhode Island, Kingston, RI 02881.

USING THE GIS-BASED MANAGE METHOD TO REDUCE NUTRIENT LOADING TO BLOCK ISLAND'S COASTAL WATERS AND AQUIFERS

The Town of New Shoreham has designated the Great Salt Pond, freshwater ponds, and the Island's sole source aquifer as critical water resources requiring special protection from the impacts of future development. Identified threats are primarily bacteria and nutrients from septic systems and stormwater runoff. Taking advantage of the town's extensive geographic information database, the University of Rhode Island Cooperative Extension is working with the Town of New Shoreham to spatially identify pollution problem areas and compare the relative contribution of nitrogen and phosphorus under a range of land use and pollution control scenarios. This analysis focuses on changes in nitrogen loading to coastal waters and aquifer recharge areas with improved wastewater management and use of denitrifying septic systems. Our presentation will demonstrate use of the MANAGE watershed tool (Method for Assessment, Nutrient-loading And Geographic Evaluation of watersheds) as a decision support system to select effective management practices and support adoption of local wastewater management regulations. Because technical assistance and education in on-site wastewater technologies is an essential component of this effort, this presentation is designed to be followed by the presentation by David Dow on the URI Cooperative Extension On-Site Wastewater Training Center.

Keller, A.A., P. Hargraves, H. icon, G. Klein-MacPhce, E. K.los, C. Oviatt and J. Zhang, Department of Oceanography, University of Rhode island, Narragansett, RI 02882.

THE EFFECTS OF ULTRAVIOLET-B ENHANCEMENT ON MARINE TROPHIC LEVELS IN STRATIFIED COASTAL SYSTEMS.

The objective of our recent research at the Marine Ecosystems Research Laboratory (MERL) was to examine the effects of enhanced UV-B radiation (relative to ambient) on marine trophic levels inhabiting a stratified coastal ecosystem. For this study, living models of a coastal estuary were used. The experiments were conducted in large scale (13,000 L) marine enclosures. We examined the effects of altered UV-B radiation (elevated 50% over ambient, 10-fold DNA-weighted) on 3 trophic strata of the marine food web: the primary producers (photosynthetic algae), primary herbivores (zooplankton and their larvae) and fish eggs and larvae (*Anchoa mitchilli*, bay anchovy). The focus of our research was to determine if UV-B induced alterations at the base of the food chain were translated to measurable impacts further along the trophic web. Elevated UV-B radiation levels produced significantly different effects at different trophic levels. Phytoplankton abundance, measured as total cell counts, and biomass, measured as *in vivo* fluorescence and chlorophyll a were significantly reduced in UV-B enhanced treatments, above but not below the thermocline (2.25 m), during the second week of the experiment. ANOVAs indicated that copepod nauplii were significantly more abundant in control treatments than in UV-B enhanced mesocosms ($F=21.67$, $P<0.01$). No significant effects were found for copepodite ($F=0.05$, $P>0.83$) and adult stages ($F=1.49$, $P>0.29$) and no significant time-by-treatment interactions. T-tests revealed that neither the mortality rates ($T=0.38$, $P>0.73$) nor the growth rates ($T=0.28$, $P>0.79$) of larval anchovy were significantly affected by the experimental increase in UV-B.

Lehman, Stephen M., NOAA Hazardous Materials Response and Assessment Division, 408 Atlantic Ave., Boston, MA 02110-3350

THE NOAA SCIENTIFIC SUPPORT TEAM AND "RESPONSE SCIENCE"

At the barge NORTH CAPE spill, at the request of the US Coast Guard, the NOAA Scientific Support Coordinator (SSC) assembled a core staff of oil spill scientists from within the NOAA Hazardous Materials Response & Assessment Division. This Scientific Support Team (SST) worked directly for the Federal On-Scene Coordinator (FOSC) from within the Planning Section of the Unified Command structure. The activities of the SST were coordinated by the SSC, who remained on the FOSC's Command Staff. This relationship between the US Coast Guard FOSC and NOAA has been in place, nation-wide, since the sinking of the ARGO MERCHANT in December of 1976.

At the spill, the SST performed several key response-science tasks, all of which were directly related to the "emergency phase" of the event. Among these tasks were: oil trajectory and fate analysis, resource protection prioritization, shoreline survey and cleanup methodology, and information management. In addition, the SST formed an ad hoc "Science Committee" designed to gather input on spill related issues from the local scientific community. This committee met as often as twice a day during the spill to discuss sampling priorities, fisheries contamination and long-term analysis. The cooperation among various state, federal and the local scientific experts allowed the SST to leverage its own specialized oil spill expertise and provided the Unified Command with high quality recommendations.

Loder III, T., M. Evans, R. Boudrow, C. Coniaris, H. Benway, C. Martorano, and A. Schouderl
(Estuarine/Coastal Chemistry Laboratory, Institute for the Study of Earth, Oceans, and Space,
University of New Hampshire, Durham, NH 03824 U.S.A.)
SPRING PULSE AND ANNUAL NUTRIENT INPUT BY THE KENNEBEC RIVER TO THE
WESTERN GULF OF MAINE COASTAL ZONE

This project was designed to determine the input of nitrogen, phosphorus, and silica to the western Gulf of Maine coastal zone during the biologically critical spring period when nearly half of the annual river input occurs during a 2 month period. This high runoff occurs because of annual spring snow melt which peaks on average around the last week of April. This runoff sets up the western GOM coastal plume which can be tracked from its input into Massachusetts Bays and out into the Gulf of Maine east of Cape Cod. Nutrient concentrations and ratios in the river water are different than those in coastal seawater and may affect spring bloom and subsequent red tide dynamics as water moves down the coast. During the spring of 1994 (March 14 to May 25), 52 water samples were collected every one to three days in the Kennebec River at a location 4 km upriver from the town of Bath, ME just above the start of estuarine mixing. These samples were analyzed for the following components: dissolved inorganic nutrients including: nitrate, nitrite, ammonium, phosphate, and silicate; dissolved organic nitrogen and phosphorus; and particulate carbon, nitrogen, and phosphorus. The concentrations of all nutrients after the spring runoff period were about one half of their concentration prior to this period and continued to decrease during the summer months. However, concentrations of particulate nitrogen, carbon and phosphorus increased during high flow periods. Using these and other unpublished data, including samples collected early in the year and during the late summer months, we were able to estimate the river nutrient concentrations throughout the year. Using these data and river flow rates, we were then able to calculate nutrient ratios and mass inputs of the different forms of these nutrients into the coastal zone during the critical spring period and estimate annual inputs into the western Gulf of Maine.

Lord, P.B., Providence Journal Co., 75 Fountain St., Providence, R.I. 02902.
HOW SCIENTISTS DEAL WITH NEWS REPORTERS WHEN DISASTER STRIKES.

Scientists in academia and government agencies often complain that the public doesn't understand or appreciate what they do. But how do they react when disaster strikes and the public's appetite for technical information becomes voracious? Observations of the media frenzy surrounding the North Cape oil spill revealed a wide range of responses from the scientific and technical community. Some organizations, such as the Coast Guard, clearly know how to handle the limelight and provide the public with a positive image of their work. Other agencies and institutions don't seem to have the staff or the mission to present themselves well.

Mazurkiewicz, Michael, Univ. Southern Maine, Portland, ME 04103
THE DISTRIBUTION OF SCALES AT DIFFERENT SCALES

A sessile, sap-feeding scale insect, Haliaspis spartinae, has been found living abundantly on the salt marsh grass Spartina alterniflora along a small Maine estuary -- a new northern distribution record. This insect has a soft legless body covered by a white waxy deposit, the scale. An exception to this are two motile stages each lasting less than 24 hours: newly hatched crawling juveniles and winged adult males. Despite limited dispersal capability, the species has an extensive but disjunct geographic distribution inhabiting either S. alterniflora or S. foliosa at 12 recorded localities scattered along the Atlantic, Pacific and Gulf coasts of the U.S. How can this distribution be explained? Have the scales been overlooked? This and other intriguing issues regarding distributional patterns of H. spartinae scales at progressively smaller scales, spatial that is, will be presented, scaled down, of course.

Morgan, Pamela A. and Frederick T. Short, Jackson Estuarine Laboratory, University of New Hampshire, Durham, NH, 03824. **ASSESSING PRIMARY PRODUCTION AND SEDIMENT RETENTION IN CREATED SALT MARSHES OF THE GREAT BAY ESTUARY, NEW HAMPSHIRE**

Over the past twenty years, many salt marshes have been constructed as mitigation for the loss of salt marsh acres in New England. This study is assessing several functions of created salt marshes in the Great Bay Estuary and comparing them to those of natural salt marshes in the same estuary. In particular, it focuses on the smaller, fringing salt marshes which are common in ME and NH. Twelve natural marshes were selected using principle component analysis for comparison with five created marshes of different ages. Two important salt marsh functions investigated in the summer of 1996 were retention of sediments and primary production. Five sediment ??? were placed in each marsh in July and again in August to measure short-term sediment deposition. Preliminary results indicate that created marshes trap sediments at a similar or greater rate than natural salt marshes. End-of season standing crop and below-ground biomass were collected from six random 0.25m² quadrats in created and natural sites and analyzed.

M.E. Mroczka, and T. Casanova; Cedar Island Marine Research Laboratory, P.O. Box 181, Clinton CT 06413; R. Goldberg, J. Pereira, P. Clark, S. Stiles, J. Choromanski, and D. Schweitzer; National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Milford Laboratory, 212 Rogers Ave., Milford CT 06460; F.E. Pellegrino, Department of Biology, Southern Connecticut State University, 501 Crescent St., New Haven, CT 06515.
CULTURE OF THE BAY SCALLOP, (*Argopecten irradians*) WITHIN A SMALL-BOAT MARINA ON LONG ISLAND SOUND (CONNECTICUT)

An innovative suspension-culture rack system was designed to evaluate the potential of intermediate aquacultural grow-out of shellfish seed within a marina in Clinton, CT. Conventional dock space in the marina was modified by cutting out sections of the decking. The cut-out sections were replaceable allowing normal usage of the dock. Wire-mesh cages (1m X 0.5m X 0.5m), containing four shelves were constructed and suspended below the modified docks. Scallop seed were contained on the shelves of the cages within flexible plastic mesh bags with temporary closures of slit PVC pipe at the ends. About 6,000 animals with an initial shell height of 15.5 mm were reared at different densities and in different mesh sizes from June through November of 1995. The use of the space under the docks caused little interference with normal marina activity. Based on the findings of this project there seems to be a good potential for intermediate grow-out of scallop seed at marinas as a step in intensive aquacultural production or in seed transplant efforts to restore scallop fisheries to natural habitats.

M.E. Mroczka, and T. Casanova, Cedar Island Marine Research Laboratory, P.O. Box 181 Clinton, CT 06413. P.E. Pellegrino, Dept. of Biology, Southern Connecticut State University, 501 Crescent St., New Haven, CT 06515; T.A. Randall and J.K. Carlson, Dept. of Biology, University of Mississippi, University MS 38677.
FEEDING HABITS OF JUVENILE WINTER FLOUNDER (*Pleuronectes americanus*) WITHIN A COASTAL MARINA AND ADJACENT INTERTIDAL HABITATS

The winter flounder is an important commercial and recreational species along the temperate Atlantic coast. There has been considerable interest in fishery research quantifying trophic interactions both between and within finfish populations. Feeding habits and trophic overlap were examined between four size classes of juvenile winter flounder collected from within a marina basin and from adjacent intertidal flats. The study area is a large 400 slip marina (Cedar Island Marina) located in Clinton Harbor (Clinton, CT).

Polychaetes were the major food source for flounder < 99mm both within the marina and on the flats. Crustaceans were dominant in the larger size classes. The dominant prey species within the marina and the flats were, however, distinctly different. The dominant prey species within the marina (*Streblospio benedicti*) is a stage I (opportunistic) while over the flats a stage III (equilibrium) species, (*Leitoscoloplos robustus*) predominated.

M.E. Mroczka, and T. Casanova, Cedar Island Marine Research Laboratory, P.O. Box 181 Clinton, CT 06413; T.A. Randall and J.K. Carlson, Department of Biology, University of Mississippi, University, MS 38677. P.E. Pellegrino, Department of Biology, Southern Connecticut State University, 501 Crescent St., New Haven, CT 06515

COASTAL MARINA BASINS AS POTENTIAL FISHERY HABITAT WITH SPECIAL EMPHASIS ON NURSERY FUNCTION

Marina basins are man-made dredged habitats that are conspicuous features of coastal ecosystems. Marinas have important recreational and economic importance, but their ecological role in coastal ecosystems is largely unknown.

The major purpose of this study was to evaluate the functional role of a coastal marina basin as fishery habitat with major emphasis on nursery function. The study area is a large 400 slip marina (Cedar Island Marina) located in Clinton Harbor (Clinton, CT).

Finfish community structure within the marina basin (1989-1993) was monitored on a weekly basis using a series of 1 cubic meter fish traps and a 1 meter beam trawl. A total of 37 finfish species representing 25 families were collected from within the marina basin. The numerical dominants were found to be winter flounder, tomcod, white perch, grubby and blackfish.

A total of 28 juvenile size finfish species were recovered from within the marina. It is apparent from this study that the Cedar Island Marina Basin is serving as finfish nursery habitat.

Nowicki, B., Requentina, E, Van Keuren, D., Graduate School of Oceanography, Narragansett, RI. 02882 and J. Portnoy, National Biological Service, Cape Cod National Seashore, Wellfleet, MA.

CAN SEDIMENT DENITRIFICATION EFFECTIVELY INTERCEPT GROUNDWATER NITRATE FLOW THROUGH SANDY COASTAL SEDIMENTS?

Denitrification (bacterial reduction of NO_3 to N_2 gas) in coastal sediments can be an important nitrogen sink, converting fixed N that might otherwise be available to primary producers to N_2 gas that is lost to the atmosphere. Nitrate in groundwater contaminated by individual septic systems is a potentially important source of N to the Nauset marsh/estuarine system on Cape Cod, Massachusetts, however the efficiency of denitrifying bacteria in intercepting and reducing this N load is unknown. Rates of denitrification observed at 5 stations in Nauset Marsh ranged from 0-50 $\mu\text{mol N}_2 \text{ m}^{-2} \text{ h}^{-1}$, were highest in winter/spring, and frequently non-detectable in late summer. Although denitrification was ubiquitous in the zones of groundwater discharge its efficiency of N removal was apparently limited by the availability sediment organic matter.

Orson, R.A., R.S. Warren and W.A. Niering, Arboretum and Botany Department, Connecticut College, New London, CT 06320. GLITTER: IT'S NOT JUST FOR COSTUMES ANYMORE

These meetings come at a time of year when the leaves fall and thoughts turn to Halloween. And what would Halloween be without the glitter that makes the costume sparkle. Of course those of you who have attended NEERS meetings in the past know that glitter can also have scientific applications as well. Using glitter and a few other techniques (radioisotope analysis, palynology and sediment analysis) we have been reconstructing the history of the Barn Island marshes in eastern CT and interpreting the impacts of sea level rise on marsh development processes during the last century. Our findings suggest that dominant Spartina communities do not record short-term fluctuations in sea levels (<10 years), rather they respond to changes which occur over periods of 3 to 5 decades. However, other communities may respond more rapidly to sea level variations and instigate changes to the system. Recent observations on the conversion of Juncus belts to Triglochin could severely hamper transgressive marsh sequences and reduce or change the structure of the future marsh community. Tidal marsh development at Barn Island follows a model of punctuated equilibrium with periods of storm activity important in driving marsh accretion processes.

Paton, P.W.C. Dept. of Natural Resources Science, Univ. of Rhode Island, Kingston, RI 02881.
EFFECTS OF THE NORTH CAPE BARGE OIL SPILL ON AVIAN POPULATIONS
WINTERING IN COASTAL RHODE ISLAND.

On 19 January 1996, the tug Scandia and its barge, the North Cape, grounded 100 m off Moonstone Beach at Trustom Pond National Wildlife Refuge, RI. This resulted in the release of over 828,000 gallons of #2 heating oil into Block Island Sound. Within two weeks of the spill, 299 avian carcasses were recovered from local ponds and beaches representing 33 species including 43 Common Eiders, 40 Herring Gulls, 33 Great Black-backed Gulls, 26 Common Goldeneyes, 26 Red-breasted Mergansers, and 14 Common Loons. In addition, 109 birds were initially found alive, of which 8 were rehabilitated and released. Surveys found little waterbird use within 1.5 km of the barge for up to five weeks. The short-term changes in the spatial distribution patterns of birds in coastal waters near the spill and adjacent waters will be discussed.

Leslie Patton, Kay Ho, James Latimer, Marguerite Pelletier, Richard McKinney, Richard Pruell, Saro Jayaraman, U.S. Environmental Protection Agency, Atlantic Ecology Division, 27 Tarzwell Drive, Narragansett, RI 02882. ASPECTS OF CHEMISTRY AND TOXICITY OF THE NORTH CAPE OIL SPILL.

On January 19, 1996, 800,000 gallons of Number 2 home heating oil were spilled from a barge into the waters off the south shore of Rhode Island. Number 2 oil is toxic to many marine organisms and especially affects the benthic community. Petroleum toxicity is caused primarily by a wide array of polycyclic aromatic hydrocarbons (PAHs) such as fluorenes, phenanthrenes, and naphthalenes. Furthermore, populations of benthic organisms exposed to PAHs at sublethal levels may experience dramatic mortalities following subsequent exposure to UV radiation. To evaluate possible impacts of this spill, sediment and water samples were collected from sites in the vicinity of the barge at 2, 6, 13, 33, 62, 132, and 189 days following the event. Sediment extracts were chemically analyzed using GC/MS for characterization and measurement of PAHs. Sediment toxicity tests were conducted using the 96-hour amphipod mortality test with *Ampelisca abdita*, and phototoxicity tests were performed using the bivalve embryo/larval development test with *Mulinia lateralis*. Initial chemical and toxicological analyses revealed that the most significantly affected area was inside the Harbor of Refuge, 3 miles east of the actual spill. PAH concentrations and toxicity remained high in at least one area of the Harbor of Refuge until 189 days after the spill. Additionally, *M. lateralis* exposed to seawater from the spill indicated that phototoxicity was present shortly following the spill. Measurements will continue to be made in the Harbor of Refuge and surrounding sites to monitor further changes in PAH concentrations and toxicity.

P.E. Pellegrino, Department of Biology, Southern Connecticut State University, 501 Crescent St., New Haven, CT 06515; M. Mroczka and T. Casanova, Cedar Island Marine Research Laboratory, P.O. Box 181 Clinton, CT 06413
THE LIVING SEASHORE: AN INTERACTIVE MULTIMEDIA GUIDE TO THE
INVERTEBRATES OF HAMMONASSET STATE PARK (MADISON, CT.)

The Living Seashore is a computer driven, hypermedia, laserdisk display that incorporates live video footage and biological descriptions of over 75 invertebrate species common to Hammonasset State Park (Madison, CT). This production allows visitors to the park's Nature Center to learn in a dynamic way about the functional importance of intertidal habitats and to appreciate the beauty and ecological value of invertebrate animals.

The Living Seashore allows visitors to see magnified closeup views of living invertebrate animals with their natural colors rather than just looking at preserved specimens in jars.

Pregnall, Marshall, Vassar College, Maribel Pregnall, Bard College, and Steven Rumrill, South Slough National Estuarine Research Reserve
MULTI-YEAR CHANGES OF EELGRASS AND MACROALGAL ABUNDANCE FOLLOWING HARVEST OF COMMERCIALY GROWN OYSTERS

Many estuaries are utilized for aquaculture of shellfish, including oysters, *Crassostrea gigas*, often in areas of seagrass populations. Four study plots of stake-culture oysters growing in a low-intertidal eelgrass, *Zostera marina*, community were harvested in 1992 in the South Slough National Estuarine Research Reserve, Charleston, Oregon. Two of the harvested plots were transplanted with eelgrass and the other two were allowed to recover naturally; each of the four study plots had an adjacent control plot. In the year following oyster harvest, monthly surveys of eelgrass shoot abundance (and many other parameters) indicated that the transplant plots re-established abundant eelgrass shoots and converged with the control plots more rapidly than the natural plots. Macroalgal biomass declined significantly in all treatments and controls. In subsequent years, eelgrass shoot abundance and eelgrass biomass increased further, slightly more so for transplanted rather than natural plots. Macroalgal biomass has fluctuated dramatically between years across all treatments and controls, suggesting that factors other than oyster culture and harvest are responsible for its abundance.

Reddy, C. M. and J.G. Quinn, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI 02882.
THE GEOCHEMISTRY OF THE NORTH CAPE OIL IN THE COASTAL WATERS OF SOUTHERN RHODE ISLAND

To determine the amount and distribution of petroleum in the coastal waters of southern Rhode Island one week after the North Cape oil spill, EPA scientists collected surface and bottom water samples along six transects and preserved them. We analyzed these samples for both total petroleum hydrocarbons (PHCs) and polycyclic aromatic hydrocarbons (PAHs), and the concentrations of PHCs and PAHs ranged from $16.6 \mu\text{g L}^{-1}$ to $4240 \mu\text{g L}^{-1}$ and $0.215 \mu\text{g L}^{-1}$ to $115 \mu\text{g L}^{-1}$, respectively. Generally, the bottom samples at each site were more enriched in PHCs and PAHs than the surface samples, and the PHCs and PAHs in all samples decreased offshore and away from the location of the wrecked North Cape barge. The chemical and physical processes that affected the oil in the water column, such as adsorption, advection, evaporation, and biodegradation, will be discussed in relation to the observed distributions of hydrocarbons in these samples.

Rolih, K. M. Department of Biological Sciences, Smith College, Northampton, MA 01063.
PHYSIOLOGICAL AND MORPHOLOGICAL EFFECTS OF NO. 2 FUEL OIL ON THE MACROALGAE *LAMINARIA SACCHARINA*, *ULVA LACTUCA*, AND *FUCUS VESICULOSUS*.

In laboratory experiments I have been investigating the effects of No. 2 fuel oil on photosynthetic performance, pigment concentrations, and morphological changes in *Laminaria saccharina*, *Ulva lactuca*, and *Fucus vesiculosus*. Preliminary results for *L. saccharina* indicate susceptibility to high oil concentrations (.1% and 1%) compared to controls at exposures greater than 24 hours with increasing ambient water temperatures. Maximum photosynthesis (P_{max}) was inhibited at these higher concentrations and exposures. P_{max} and pigment concentrations were inexplicably enhanced in *Ulva lactuca* in early summer (4 and 48 hr exposures at .1%), but as ambient water temperatures increased and thalli aged, photosynthetic performance declined while pigment concentrations remained stable. P_{max} declined in *Fucus* after 24 hour exposures at low and high oil concentrations (.005% and .1%). Given a two-day recovery from low and high oil concentrations, P_{max} in *Fucus* was higher than in samples given only a one-day recovery, performing as well as controls. An interesting morphological change that occurred with *Fucus* was the loss of surface hairs with increasing oil concentrations and exposures. Their loss could indicate a stress response at these oil concentrations. Data on photosynthetic-irradiance (PI) curves and pigment concentrations will be presented.

Short, Frederick T., Raymond E. Grizzle, David M. Burdick, Ryan Davis, and Arthur C. Mathieson. Jackson Estuarine Laboratory, University of New Hampshire, 85 Adams Point Road, Durham, NH 03824. IMPACTS OF A SMALL OIL SPILL IN A SMALL ESTUARY.

On the night of July 1, 1996, a Maltese-flagged oil tanker named the *Provence*, broke its moorings, severing a hose that was pumping #6 fuel oil to the Public Service of New Hampshire power plant in Newington, New Hampshire. The U.S. Coast Guard reported that approximately 1,000 gallons of this heavy oil was spilled into the Piscataqua River. The spill occurred during maximum flood current of a spring tide two hours before high tide. Subsequently, a second spill of diesel fuel occurred when an anchor of the *Provence* punctured its fuel storage tank. Forty-eight hours after the spill, oil was evident throughout the Great Bay Estuary from the mouths of its tributaries to the open coast. The oil, which sank quickly after spilling, formed soft tar balls in the sediment that were distributed widely. Within days after the spill, lobsters, horseshoe crabs, and a few birds were found heavily coated with black, sticky oil. Six thousand oiled lobsters were brought into collection sites by lobstermen, and over 1,000 dead horseshoe crabs were found. Monitoring of heavily oiled salt marsh, eelgrass, and fucoid algal habitats is currently under way. Preliminary results show a 20% reduction in fucoid algal growth during the first month after the oil spill. Despite the small size of this oil spill, there has been measurable damage to the estuarine flora and fauna.

Spelke, Jessica A and Francis C. Golet Department of Natural Resources Science, University of Rhode Island, Kingston, RI 02881. DISTRIBUTION AND ABUNDANCE OF *MELAMPUS BIDENTATUS* AT THE GALILEE SALT MARSH PRIOR TO RESTORATION

In 1956 the Rhode Island Department of Transportation constructed a 4-lane east-west highway, known as the Escape Route, across a 60-ha salt marsh in Galilee, RI. The southern 50 ha, known as the Galilee Bird Sanctuary, receives only limited tidal flow through two 75-cm culverts. As a result, the former marsh has changed to a *Phragmites australis* and shrub-dominated wetland with two remnant pockets of salt marsh totaling only 3.6 ha. Late in 1997, a salt marsh restoration project will reestablish full tidal flow to the Sanctuary. Analysis of data collected during the summer of 1996 indicate that the distribution and density of *Melampus bidentatus*, the tidal marsh snail, are distinctly different on the two sides of the road North of the Escape Route, where the tidal range averages 0.75-1.5m, mean snail density (n=55) was 412 snails/1W. Snails were found predominantly in salt meadow (*Spartina patens*, *Juncus gerardii*, *Distichlis spicata*) and short (<1.2m) *Phragmites*. South of the road, where tidal amplitude averages only 15-20 cm, snail density averages 4 snails/m² (n=40) in one pocket of salt marsh and 40 snail/m² (n=48) in another. Snails were found only in salt meadow and *Spartina alterniflora*. Researchers at URI will monitor *Melampus* populations for several years after marsh restoration and attempt to document the specific environmental factors responsible for changes in snail density and distribution over time.

Stuen-Parker, J. Boston Bass Brigade, 661A East Broadway Boston, MA 02127; Cate O'Keefe and Lynn Miller, Hampshire College, Amherst, MA 01002; Michael Sutherland, Univ. of Massachusetts, Amherst, MA 01003. **STRIPED BASS IN BOSTON HARBOR WHERE DO THEY COME FROM?**

Striped bass populations in Boston Harbor are potentially from two sources; the Bay of Fundy and the Chesapeake Bay. To distinguish between these sources we compared soft fin ray patterns and total number of fins of fish collected from the Harbor. Fish known to originate from Bay of Fundy or Chesapeake Bay can be statistically differentiated by these morphological fin characteristics. Our bootstrapping (resampling with replacement) data shows that most of these fish are likely to originate in the Bay of Fundy.

Theel, Jonathan, Ensign and Peabody, Scott W., Cadet 1/C, Department of Science, U.S. Coast Guard Academy, New London, CT 06320.

ENVIRONMENTAL EFFECTS OF DISCARDED BATTERIES ON ESTUARINE LIFE

The United States Coast Guard has throughout the navigable waters of the U.S. approximately 15,300 lighted aids to navigation (buoys & daymarkers) which are battery powered. A practice, in years past, was to dump used batteries into waters adjacent to the lighted aids after servicing the aids. In recent years surveys of those discarded batteries have found them in a variety of physical conditions ranging from completely disintegrated to completely intact. The physical integrity of batteries could be expected to have a large effect on the release of associated contaminants into the estuarine environment.

During the past three years, studies have been conducted at the U.S. Coast Guard Academy to identify any contaminants released by the batteries and their effect on the estuarine environment. Those studies showed that it was the corrosion of the stainless steel electrodes releasing Chromium and Nickel rather than the Lead acid from the body of the batteries that posed the greater risk to the environment.

Additional studies in a closed system involving *Cyprinodon variegates* (sheepshead minnow) and intact batteries, of which only the electrodes were immersed, showed clear avoidance responses on the part of the minnows. As concentrations of the metals rose, the minnows exhibited symptoms of chromium poisoning and eventually died. The U.S. Coast Guard is actively involved in recovery of all discarded batteries in coastal and estuarine waters and marshes.

Torgan, John B., Narragansett BayKeeper, Save The Bay, 434 Smith St., Providence, RI 02908-3770.

THE ROLE OF PUBLIC PARTICIPATION IN OIL SPILL RESPONSE AND CONTINGENCY PLANNING.

Well before the Barge North Cape came aground and spilled its cargo of 828,000 gallons of home heating oil, Save The Bay, Southeastern New England's largest non-profit environmental organization, was involved in oil spill contingency planning. Designated as the official volunteer coordination and management organization for the North Cape Spill, Save The Bay drew on its vast volunteer resources and professional staff to assist in the response, damage assessment, public communications, and future spill prevention efforts.

Weston, N. B. (Hampshire College School of Natural Science, Amherst, MA 01002), A. Giblin, G. Banta, C. Hopkinson, and J. Tucker (Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA 02543).

ESTIMATING DENITRIFICATION IN SEDIMENTS OF THE PARKER RIVER ESTUARY. MA.

We measured denitrification in subtidal and intertidal sediment cores from the Parker River Estuary, Massachusetts, an LMER site. Coupled nitrification-denitrification was measured in the cores by comparing measured inorganic nitrogen release from the sediment to four estimates of inorganic nitrogen production: (1) dissolved inorganic carbon (DIC) and (2) phosphate release, (3) oxygen uptake, and (4) anaerobic ammonium production. Direct denitrification was measured by nitrate uptake from the overlying water. Additionally, $^{15}\text{N}_2$ accumulation in overlying water enriched with $^{15}\text{NO}_3^-$ was measured, as an estimate of total (direct and coupled) denitrification. Between 25% and 75% of the N remineralized in the sediment was estimated to have been denitrified, indicating denitrification is a significant loss of N in the Parker River Estuary. Direct denitrification was accountable for a small percentage of total denitrification. Results from both coupled and direct denitrification measurements indicate that the intertidal sediment was more metabolically active.

Y a n g , Z. and J. N. Gearing, Department of Chemistry, University of Massachusetts Dartmouth, North Dartmouth, MA 02747. SOURCES OF SEDIMENTARY HYDROCARBONS IN WESTERN BUZZARDS BAY

Aliphatic hydrocarbons from surface sediments of Buzzards Bay were compared with those from potential sources (phytoplankton, sewage, terrestrial plants) to determine the relative influence of these sources on different locations within the bay. Principle component analysis was used to integrate the data from multiple variables. Midbay sediments showed little variation along the Cape Cod Canal-Rhode Island Sound axis, indicating considerable mixing within the bay. Coastal embayments along the mainland had-greater spacial variation, reflecting local rather than bay-wide influences. Two groups of nonparaffinic hydrocarbons were found in the sediments which may reflect levels of primary productivity.