NEERS SPRING 09 MEETING ABSTRACTS

Armstrong*, M. P.[1], G. Nelson[1], and M. Cieri[2], [1]Massachusetts Division of Marine Fisheries, 30 Emerson Ave, Gloucester, MA 01930; [2]Maine Department of Marine Resources, PO Box 8 West Boothbay Harbor, ME 04575

THE DECLINE OF RIVER HERRING: IS THERE A SMOKING GUN?

Most anadromous river herring populations along the U.S. east coast have exhibited significant declines over the last several years, precipitating fisheries closures in several states and management actions by inter-state management boards. Several potential causes of these declines exist but little data are available with which to evaluate them. Several known problems including habitat degradation and lack of passage into spawning grounds have certainly reduced populations over the long term but are not likely to cause the abrupt decline in populations recently seen. Potential causes of this recent downturn include increased predation and overfishing or high levels of by-catch in high volume small mesh fisheries such as those for Atlantic herring. An analysis of existing by-catch information from the Atlantic herring fishery indicates that an average of about 700,000 lbs of river herring are caught and retained as by-catch each year. The coastwide population of river herring is estimated at about 50 million pounds, so the level of removals seen in the Atlantic herring fishery is unlikely to be the sole cause of the east coast decline. Predation by increasing populations of top-level predators such as striped bass, seals, and commorants likely play a role in the recent declines in the river herring populations. Preliminary analyses indicate positive correlations between striped bass year class strength and total mortality of river herring. Unfortunately no single cause "smoking gun" is apparent at this time that explains the decline of river herring populations.

Barnhardt*, W.[1] and D. Sampson[2], [1]U.S. Geological Survey, Woods Hole Science Center, 384 Woods Hole Rd., Woods Hole, MA 02543; [2]Massachusetts Office of Coastal Zone Management, 251 Causeway St., Suite 800, Boston, MA 02114

GEOLOGIC MAPPING IN MASSACHUSETTS STATE WATERS: THE KEY TO EFFECTIVE OCEAN MANAGEMENT

The Massachusetts coastal ocean encompasses more than 6530 km^2 (2521 mi^2) of diverse seafloor environments, including submerged rock ledges, extensive sand deposits, rugged boulder fields, and deep muddy basins. Effective management of ocean resources in this complex region, as envisioned in the *Massachusetts Oceans Act of 2008*, will require detailed knowledge of the type and distribution of benthic marine habitats, which are strongly controlled by seafloor geology. The geologic factors that primarily determine habitat suitability for benthic organisms are bathymetry (i.e., seafloor topography) and substrate type (i.e., rock, gravel, sand, mud). A cooperative program involving the U.S. Geological Survey, Massachusetts Coastal Zone Management, and the National Oceanic and Atmospheric Administration is using high-resolution sonars, bottom photography, and sediment sampling techniques to fully characterize seafloor geology in water depths greater than about 10 m (33 ft). Mapping began in 2003 and, to date, has covered 1850 km^2 (714 mi^2) of seafloor, approximately 28% of the total area inside the 3-mile limit of state jurisdiction. Over the next five years, the joint USGS/CZM/NOAA program will expand seafloor mapping into areas within Massachusetts waters where knowledge about the physical structure of the seafloor is currently lacking. The long-term goal is to map all of the state's waters. This presentation gives examples of how mapping can be used to support

management decisions, and stresses the importance of understanding geologic framework when attempting to predict (model) coastal erosion and other environmental changes.

Bowen*, R.[1] , R. J. Mooney[2], C. Windsor[2], and A. Lockwood[2], [1] In-Situ Inc., 31 Bolivar Avenue, Troy, NY 12180; [2] In-Situ Inc., 221 E. Lincoln Avenue, Fort Collins, CO 80524

USING SPECIFIC CONDUCTANCE AS A SURROGATE FOR CHLORIDE IN SALTWATER MARSHES

Many salt marshes are experiencing deterioration and dieback, and several factors can contribute to salt marsh degradation, but not all causations have been delineated. Investigations into salt marsh deterioration typically monitor salinity and tide level fluctuations. Chloride is a chemically conservative constituent and is used to characterize salinity in water samples. In brackish waters and seawater, specific conductance (SC) can be directly correlated to chloride concentration. Raw data of temperature-compensated SC can be converted to chloride concentration using a pre-determined conversion factor. With continuous monitoring, scientists can map trends in the hydrological conditions of the salt marshes. Due to the inherent measurement challenges of chloride ion-selective electrodes (ISEs) and the high cost of chloride analysis by ion chromatography (IC), a viable field method for estimating chloride values in continuous monitoring applications is needed. To validate the relationship between SC and chloride, SC measurements by electrochemical conductivity cells and chloride concentration measurements by ISE were determined for 35 PSU OSIL Atlantic Seawater Standard and 10 dilutions at six different temperatures (66 unique samples). A strong linear relationship was established, thus demonstrating the validity of using SC as a reliable surrogate for chloride estimation. This study also compared measurement drift of a chloride ISE and a conductivity sensor under controlled laboratory conditions. Minimal drift of the conductivity sensor coupled with a large drift of the chloride ISE demonstrates a significant advantage of using conductivity sensors for water quality checks, long-term monitoring, and field deployments.

Charbonneau*, D.J. and G.L. Chmura, Department of Geography, McGill University, 805 Sherbrooke St W, Montreal, QC H3A 2K6.

IMPORTANCE OF MANGROVES AND SALT MARSHES TO GLOBAL BIODIVERSITY

Our study evaluates the contribution of North American salt marshes and mangroves to global biodiversity by examining the number of endangered and threatened species dependant upon these habitats. Using species lists published by the International Union for the Conservation of Nature (IUCN), the U.S. Fish and Wildlife Service (USFW), and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), we determined which were dependant upon wetlands, and specifically saline systems for some aspect of their life cycle. We limited our study to vascular plants, birds, mammals, reptiles, and amphibians; and excluded aquatic species. Of those listed by COSEWIC and the USFW, ~30% (124 and 145 species, respectively) use wetlands to some degree, while 37% of IUCN's listed species (130) are wetland dependent. We have determined that, in the U.S., 18% of the wetland-dependent endangered species utilize salt marshes or mangrove swamps, and in Canada 5% of wetland species use salt marshes. Although only 5% of the area of U.S. wetlands is tidal, >11% of the endangered species that are wetland dependent are actually restricted to the intertidal wetlands during at least one life stage. Numbers in Canada are much smaller; <1% of Canada's wetlands are tidal and 2% of the wetland species are obligatory salt marsh users. We suggest that salt marshes and mangroves have a disproportionate importance for rare and endangered species in North America.

Cheney*, D.[1], A. Meador [1], S. Greenwood [2], and K. Gardner [2], [1] Biology Dept. and Marine Science Center, Northeastern University, Boston, MA, 02115; [2]Environmental Research Group, Dept. Civil Engineering, University of New Hampshire, Durham, NH, 03824.

COULD A PCB-CONCENTRATING SEAWEED BLOOM IN NEW BEDFORD HARBOR BE REDUCING PCB TRANSFER UP ITS FOOD CHAIN?

In the summer of 2007, we discovered a bloom of the green macroalga Ulva lactuca growing in the upper portion of New Bedford Harbor (NBH); an area designated a Superfund Site since 1982 because of its extremely high levels of PCBs. Based upon quadrat data collected in July, 2008, we estimated there was over 18 tons of Ulva just along the western shoreline of the Upper Harbor between Coggeshall and Wood streets. The concentration of (total) PCBs in Ulva samples collected from the Upper Harbor ranged from a high of 98 ppm to a low of 2 ppm. PCB concentrations in Ulva were correlated with distance from the Aerovox plant, where PCBs were used in the manufacture of electrical transformers and capacitors from ca. 1940 to 1977. Our highest PCB conc. (98 ppm) is almost 100 times greater than the highest conc. previously reported for macroalgae. The most abundant congeners in this sample consisted of di, tri, tetra and pentachlorobipheyl isomers. We also measured PCB uptake by uncontaminated Ulva plants placed in intertidal cages above Aerovox and found rates as high as 4 ppm in just 24 hrs. In laboratory grazing experiments on NBH Ulva by the most common herbivore we saw, mysid shrimp, we found a very low rate of herbivory. Because of the large amount of PCBs taken up by Ulva in the Upper Harbor and what appears to be a low herbivory rate, we believe the Ulva bloom in NBH may be reducing the amount of PCBs taken up by phytyoplankton in the system and transferred up the food chain. Thus, the Ulva bloom in New Bedford Harbor may be having a previously unknown, beneficial effect on the transport and bioaccumulation of PCBs in the system.

Corman*, S.S. [1], and C.T. Roman [2], [1] Graduate School of Oceanography, University of Rhode Island, Narragansett, RI 02882; [2] National Park Service, University of Rhode Island, Narragansett, RI 02882.

SALT MARSH MOSQUITO DITCHES AS HABITAT FOR NEKTON AND IMPLICATIONS FOR RESTORATION

Salt marshes have long been subjected to the digging of parallel grid ditches for mosquito control. In response to the federal wilderness designation of a portion of the Fire Island (NY) barrier island (including salt marshes), the National Park Service is considering a restoration effort to remove the ditches from the marshscape. Prior to implementing a ditch removal strategy, it is important to understand the habitat support function of the ditches. This study compared nekton (free-swimming fish and decapod crustaceans) utilization of ditches and natural tidal creeks. Nekton community composition, individual species density, species richness, and environmental data (salinity and temperature) were evaluated for both habitat types. Preliminary findings show that creeks have higher species richness than ditches. Community composition analysis showed that a difference exists between creeks and both open-mouthed and plugged ditches, and between ditch uplands and ditch mouths. By understanding the role of ditches as habitat for marsh nekton, the implications of the removal of this habitat will be realized. In addition, analysis of pre-ditch marsh conditions was conducted to establish a target for the restoration of this landscape. Grid ditches are prolific in the Northeastern U.S., so this study will benefit others contemplating restoration of ditched marshes.

Crescenzi*, E.[1], J.B. Hubeny[1], J.K. Buttner[2], M. Fregeau[2], S. Weston[2], and T. Shields[3], [1] Department of Geological Sciences, Salem State College, Salem MA 01970; [2] Northeastern Massachusetts Aquaculture Center and Department of Biology, Salem State College, Salem MA 01970; [3] Massachusetts Division of Marine Fisheries, Gloucester MA 01930

GRAIN SIZE CHARACTERIZATION AND SOFT SHELL (*MYA ARENARIA*) CLAM SURVIVAL RATES IN SELECTED BOSTON HARBOR TIDAL FLATS

A collaborative project between the Massachusetts Division of Marine Fisheries and Salem State College has focused on the restoration and enhancement of Boston Harbor soft shell clams (*Mya arenaria*). As part of this project, the sediment characteristics of a number of stocked and monitored tidal flats were analyzed in order to assess the geologic impact upon the fauna. Grain size analyses were performed on sediment samples taken from sixty-four sites in Hingham, Hull, Quincy, Weymouth, and Winthrop and were compared with clam survival data from the same sites. Samples were taken in the center of 600 ft^2 areas stocked with juvenile clams using a 3" diameter corer. Samples were taken to 12" sediment depth, or refusal, and homogenized before analysis. Approximately 50 grams bulk sediment from each site was used for grain size analysis. Organic matter was removed by adding 15mL 10% Hydrogen Peroxide and stirring until reaction was complete. The treated sediment was wet sieved through a 63μm sieve to isolate the silts and clays. Sands and gravels were dried and subsequently dry sieved using a RoTap machine with sieves at 1 phi resolution. Results were calculated as dry weight percentages of gravel, very coarse sand, coarse sand, medium sand, fine sand, very fine sand, and silt/clay. Results reveal variability of sediment size within and among locations. For instance, the Post Island Road location (Quincy) has sites dominated by gravel and coarse sand as well as coarse to medium sands. In addition, preliminary results suggest that clam survival may be influenced by sediment size.

Dailey, A.*, Pavri, F., Valentine, V and G. Mueller

MONITORING THE SALT MARSHES OF WELLS MAINE USING NASA'S ASTER IMAGERY

It is a well established fact that coastal wetlands provide many valuable benefits to humanity, including providing a buffer against storms and filtering pollutants from the water. Concern over global climate change and continued local development presents the need to monitor and study how coastal wetlands are affected by these potential threats. This study investigates the utility of multispectral satellite imagery as a tool to monitor how the salt marsh ecosystem at the Wells National Estuarine Research Reserve (NERR) adapts to changing conditions in the surrounding environment. A geospatial database containing field observations of vegetation at the Wells NERR facility was assembled as part of a collaborative effort between various non-profit, educational, and government agencies. These data were used in conjunction with Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) satellite imagery and spectral classification algorithms to produce a species level map of the Wells NERR facility. Additional field observations and statistical analysis were used to assess the accuracy of this map. The findings demonstrate that this technique may significantly reduce the amount of labor required to map wetlands when compared to traditional field surveying methods.

Dettmann, E.H. USEPA, Office of Research and Development/NHEERL, Atlantic Ecology Division. 27 Tarzwell Dr., Narragansett, RI 02882.

CHLOROPHYLL *A* AS A BIOCRITERION IN DEVELOPING NUTRIENT CRITERIA FOR ESTUARIES

The purpose of nutrient criteria for aquatic systems is to protect their designated uses. Nutrients do not directly affect designated uses of estuarine and near-coastal waters, but can affect primary producers, which may in turn affect designated uses either directly or indirectly. Therefore, nutrient criteria need to be related to biocriteria - threshold values of biotic responses beyond which designated uses of the ecosystem are affected. The concentration of phytoplankton chlorophyll *a* is a potential candidate for a biocriterion. This biocriterion may then be used to develop nutrient criteria using established and developing relationships between concentrations of chlorophyll *a* and nutrients. Some states and other governmental agencies have adopted or proposed thresholds of chlorophyll *a* for use in assessment of water quality and ecological impairment and in development of nutrient criteria or standards for estuaries and near-coastal waters. Chlorophyll thresholds are also used to calculate some eutrophication indices. This poster describes ongoing work to summarize these thresholds and methods used to derive them.

Edmonds*, M. A., N. A. Apuzzo, E. J. Baumgaertner, J. A. Lembo, and Sr. M. J. Paolella; Sacred Heart Academy, Hamden, CT

SEQUENCING THE *LIMULUS* MITOCHONDRIAL COX II GENE: COMPARISON OF ECOLOGICAL VARIATIONS AND SNPS IMPLICATED IN BREAST CANCER

Sacred Heart Academy students are studying the conserved cytochrome oxidase (COX or CO) gene, composed of three subunits, all of which may develop mutations implicated in carcinomas. Because COX II is expressed at higher levels in 40% of human invasive breast cancers, this particular subunit is the focus of this study. The last enzyme in the respiratory electron transport chain, COX II is comprised of 685 base pairs from n.1540-2224.

The templates are derived from *Limulus polyphemus*, one of the oldest arthropods which has not endured significant evolutionary adaptations. The horseshoe crab's blue blood contains LAL (*Limulus* amoebocyte lysate), a protein that coagulates in the presence of bacterial endotoxins, namely gram negative bacteria, establishing its medical significance as a sterility determinant. Sacred Heart Academy students are comparing multiple specimens from Long Island Sound to samples from the Massachusetts and the Delaware/Chesapeake Bay areas.

Students isolated DNA from blood, claw and sperm tissues using chemically treated FTA Cards. They then designed two sets of overlapping primers, spanning nucleotides 1459-2355 in order to encompass the entire COX II gene. After amplifying the gene using student-designed PCR parameters, the products were purified using column micro-centrifugation and sequenced using an ABI Prism 310 Genetic Analyzer. Results were evaluated to identify possible variations among the crab samples as an evolutionary/geographical study while comparing those SNPs to genetic mutations causing cancer in humans.

Ferry*,K. H.[1], J. J. Brown[2], J. F. McKeon[3], K. Flanery, C. Ostaudelafont, M. West[4], and T. Roettiger[3], [1]Massachusetts Division of Marine Fisheries, Gloucester, MA 01930, [2]Fisheries and Wildlife Division, District Department of the Environment,Washington, DC 20002, [3]U.S. Fish & Wildlife Service, Central New England Fishery Resources Office, Nashua, NH 03063, [4]U.S. Fish & Wildlife Service, Nashua National Fish Hatchery, Nashua, NH 03063

RESTORATION OF AMERICAN SHAD IN THE CHARLES AND MERRIMACK RIVERS, MASSACHUSETTS.

American shad, *Alosa sapidissima*, were once an important component of the fish fauna of the Charles and Merrimack Rivers, Massachusetts. Shad populations were nearly extirpated from the Charles and greatly reduced in the Merrimack due to the construction of dams, water pollution, and over-fishing. Recent water quality and fish passage improvements in both rivers have created opportunities for restoration. Beginning in 2006 the Massachusetts Division of Marine Fisheries collaborated with the U.S. Fish and Wildlife Service to implement a long term program to stock hatchery reared fry in these systems. Program objectives are to restore a sustainable population of approximately 30,000 shad to the Charles, create a sport fishery, and enhance the population in the Merrimack. Fry were produced in the Nashua and North Attleboro National Fish Hatcheries using broodstock shad from the Merrimack River. All fry were immersed in an oxytetracycline bath to mark their otoliths prior to release. Between 2006 and 2008, 3.6 million fry were stocked into the Charles River. Confirmed hatchery origin juveniles were found subsequently during fall electrofishing surveys in each year. In 2009, the first two million fry produced will be released into the Charles River, and the surplus will be stocked into the Merrimack River. Adults returning to the Charles River will be collected and examined for marked otoliths beginning in 2009.

Franz, David R., Biology Department, Brooklyn College, City University of New York, Brooklyn, NY 11210

ASSIMINEA SUCCINEA (OR *MODESTA*?) – A HIGH MARSH AMPHIBIOUS GASTROPOD FROM JAMAICA BAY, NY

In New England, only a few gastropod species, including *Melampus bidentatus, Ovatella myositis, Littorina saxatilis, Hydrobia spp* and (in brackish marshes) *Succinea wilsoni* are found on the upper marsh. In Jamaica Bay, New York, an additional upper marsh species is *Assiminea succinea* (or possibly *modesta*.) *Assiminea* is a predominantly tropical genus of estuarine and freshwater, amphibious, deposit-feeding snails. In Jamaica Bay, *Assiminea succinea* is found along the upper *Phragmites/Spartina alterniflora* border, on damp sediments under wrack, pieces of wet wood, sea weeds etc. It also occurs, less commonly, on the marsh flat, often in empty (but still paired) mussel valves. Although tolerant of immersion for at least four days, snails become inactive or climb upward when submerged. On wet but emergent sediment, snails become immediately active and initiate feeding. In the laboratory, they survive a week or more in dry sediment, months in the field where humidity may be higher. Respiration in air may depend on an air bubble trapped in the mantle cavity. Sexes are separate; Individual eggs laid directly on the damp sediment undergo direct development. The New England species (*A. modesa* H.C. Lee, 1845) was described from “Brooklyn, Long Island” (possible Jamaica Bay), and later in more detail by F. N. Balch (1899) from cold Spring Harbor, Long Island. Based on similarity in shells, R. T. Abbott (1974) synonomized *A. modesta* with a Cuban species, *A. succinea* Pfeiffer (1840). Currently all Atlantic coast assimineads are assigned to this species.

Gifford*, S. J. [1], and R. W. Fulweiler [1], [1] Boston University, Boston, MA 02215

USING NITROGEN AND CARBON ISOTOPES TO COMPARE WILD AND CAPTIVE PENGUIN COLONIES

The New England Aquarium (NEAq) penguin exhibit contains three different species of penguins: Rockhopper (*Eudyptes chrysocome chrysocome*, *Eudyptes chrysocome filholi*), African (*Spheniscus demersus*), and Little Blue (*Eudyptula minor*). Between them, variations in natural habitat and diet exist. However, at the NEAq all species are combined into a single habitat and fed a slightly altered diet of smelt and capelin. We have collected samples of food, molting feathers, and guano for N and C isotopic analysis since the fall of 2008. These data will be compared to isotopic literature values of N and C from penguins in their natural environment. Such a comparison will help us to understand how closely the NEAq aquarium mimics the natural environment and how captivity affects the penguin colonies. In addition, these NEAq samples will be compared to natural samples from two Adélie penguin colonies in the Antarctic. The first colony is located next to Palmer station (an NSF funded laboratory with continual occupants) and the second colony is located on Peterman Island, a non-anthropogenically impacted site some miles away. The isotopic analysis should allow us to distinguish between the site impacted by human nitrogen and the site from a more pristine environment.

Goggins*, J. and C. Cuomo. University of New Haven, Department of Biology and Environmental Sciences 300 Boston Post Road, West Haven, CT 06516

SALT MARSH CHANGE AT THE CHARLES E. WHEELER WILDLIFE REFUGE AT MILFORD POINT, CT

The Charles E. Wheeler Wildlife Refuge, located at the mouth of the Housatonic River in Milford, CT, is a dynamic coastal marsh. The marsh, divided by a spit, is eroding in the back at a rate of 1,880 m2/yr while the foremarsh is accreting at a rate of 1,400 m2/yr. Jonas and Cuomo (2004, unpublished) determined the factors responsible for accretion of the foremarsh. This study builds upon their work by documenting rates of change in both marsh areas. Marsh patches in both areas were demarcated using a Trimble GPS and then compared to previous maps and aerial photographs using ArcGIS software. Ongoing sediment trap experiments will further characterize the erosion patterns in the back marsh. Work completed thus far demonstrates substantial increase in marsh coverage in the front marsh since 2000, while the back marsh shows evidence of erosion relative to historical extent. Overall, the growth in the foremarsh is slowing the rate of total marsh loss at Wheeler but not enough to compensate for the loss in the back. In addition to mapping the marsh, sediment traps are currently being deployed in order to determine sediment flux within the marsh. Such information is needed if managers are to effectively predict the effects of climate change on coastal areas.

Grady*, S. P.[1] , and M. Kearns[2], [1] Massachusetts Bays Program, North and South Rivers Watershed Association, Norwell, MA 02061; [2] Massachusetts Riverways Program, Division of Fish and Game, Boston, MA 02114

BALANCING ECOLOGICAL AND MUNICIPAL WATER NEEDS IN FIRST HERRING BROOK, SCITUATE, MA

The First Herring Brook is a tributary to the North River in Scituate, MA and the only "herring brook" in the North River watershed that currently lacks a spring herring run. There are multiple non-functioning fish ladders along the stream, and the two surface water impoundments are used for the municipal water supply. Prompted by a 2006 request

by the town for an increase to their water withdrawal permit and concerns over low flow conditions and a lack of anadromous fish in the system, the NSRWA/Mass. Bays and Riverways partnered with the town of Scituate and other local, state, and federal organizations to a) assess the status of the habitat in the brook and b) model the ecological and municipal flow demands. Habitat assessments were conducted during the late spring, summer, and early fall of 2007 and 2008 using anadromous fish habitat protocols being developed by Mass. Division of Marine Fisheries. The project partners have also been working with Tufts University, Stockholm Environment Institute, and The Nature Conservancy to model the supply and demand of water within the First Herring Brook system, using the Water Evaluation and Planning System or WEAP Model.

Hale, S.S. Atlantic Ecology Division, U.S. Environmental Protection Agency, Narragansett, RI 02882

A PORTUGUESE SPRING: MEASURING ESTUARINE HEALTH IN THE EUROPEAN UNION

In the spring of 2008, I spent two months in Portugal as part of the Embassy Science Fellows Program. The U.S. State Department draws upon other federal agencies to provide scientific and technical expertise to American embassies around the world. Portugal held the revolving European Union Presidency and the Embassy in Lisbon requested help with coastal and ocean issues resulting from the EU's Water Framework Directive (akin to our Clean Water Act) and Marine Strategy. My previous experience with things Portuguese (other than the man-of-war jellyfish that sometimes land on our shores) was a peripheral involvement with research my division conducts on the PCB-contaminated Superfund site in New Bedford Harbor, Massachusetts, an area with many people of Portuguese descent and common ties in (earlier) whaling, and now fishing. In Portugal, I met with government agencies, universities, and environmental groups to learn how the EU directives are being met and to explore areas for collaborative research. Fueled by strong coffee (bica) and cream tarts (pastéis de nata) at universities all over the country, I gave seminars on developing ecological indicators for the U.S. National Coastal Assessment and on the EPA research that has led to the U.S. National Coastal Condition Report. In turn, I learned about methods used to intercalibrate indicators among different EU countries. This talk compares the US and EU ways of measuring coastal and ocean health.

Hayn*, M.K.[1], R.W. Howarth[1], R. Marino[1], A. Giblin[2], K. Foreman[2], P. Berg[3], K.J. McGlathery[3], [1]Cornell University, Ithaca, NY 14853; [2]The Ecosystem Center, Woods Hole, MA 02543; [3]University of Virginia, Charlottesville, VA 22904

NUTRIENT INPUT-OUTPUT DYNAMICS IN A SHALLOW TIDAL ESTUARY ON CAPE COD

A shallow estuary on Buzzards Bay, MA (West Falmouth Harbor) has recently begun receiving increased nitrogen loading via groundwater from an aquifer contaminated with effluent from a waste water treatment facility. In shallow estuaries, a combination of hydrologic and biogeochemical processes affect the fate of nitrogen and the system's ability to act as a nitrogen sink. Changes in the rates of biogeochemical processes as a result of excess nitrogen determine the ability of the ecosystem to mediate the effects of anthropogenic nitrogen additions, including changes in biotic uptake, mineralization, denitrification, and nitrogen fixation. To examine the balance of these processes on an ecosystem scale, we are measuring the exchange of nitrogen and other biologically relevant nutrients between the estuary and adjacent oceanic waters across multiple time scales. Detailed tidal and bathymetric data are combined with frequent measures of nutrient concentration at the estuary/bay interface to calculate net transport across this boundary. Data show that the

estuary only exports nitrogen during the months with less active assimilation by primary producers, and that it retains nearly all of the nitrogen load during July and August, when productivity and assimilation are at their highest.

Hines*, M. E.[1], C. Fonseca[1], G. W. Brace[1], J. Erwin[1], and R. N. Buchsbaum[2], [1]Department of Biological Sciences, University of Massachusetts Lowell, Lowell MA 01854; [2]Massachusetts Audubon Society, Wenham, MA 01984

NITROGEN FIXATION CONDUCTED BY SULFATE-REDUCING BACTERIA IN THE RHIZOSPHERE OF *SPARTINA PATENS*

Despite the tendency of salt marsh plants to aerate their rhizosphere, plant-inhabited sediments support very rapid rates of anaerobic microbial process including sulfate reduction. Many species of sulfate-reducing bacteria have the ability to fix nitrogen and it is possible that some of this N is available to marsh grasses. To investigate whether a relationship exists between plant activity and sulfate reduction-mediated N fixation, we conducted an experiment in which we hypothesized that a plant response to aboveground clipping (simulated haying) would be enhanced release of root exudates that would in turn stimulate rhizosphere bacterial activity and N fixation via sulfate reduction. An array of 2 x 2m plots of *Spartina patens* were subjected to different clipping regimes and fertilization, and biomass, plant N and C content, pore water chemistry and rates of N fixation were determined. Clipped plots acquired more N, removed more sulfate from pore water indicating increased sulfate reduction, and exhibited more rapid N fixation rates compared to controls. Fertilized plots exhibited little to no N fixation. When sulfate reduction was inhibited, N fixation decreased by more than 75% indicating that most of the N fixation was catalyzed by sulfate-reducing bacteria (SRB). Results were complicated by variations in desiccation of plots due to slight elevation differences and effects of excessive clipping. However, it appears that plant-mediated enhancement of sulfate reduction has the potential to increase N availability in *Spartina patens* sediments.

Larsen*, P.F.[1], and S. Barker[2], [1]Bigelow Laboratory for Ocean Sciences, West Boothbay Harbor, ME, 04575 [2]Maine Department of Marine Resources, West Boothbay Harbor, ME 04575

VIRGINIAN REFUGIA AND RELICT OYSTER POPULATIONS IN MID-COAST MAINE

The Gulf of Maine has undergone a rapid and complex geological evolution since the last glaciation and the biological systems have responded accordingly leading to the globally significant patterns of biodiversity that we observe today. Briefly, in the past the Gulf of Maine was tideless and lagoonal in nature. This allowed for much warmer water temperatures and colonization by warm temperate (Virginian) species from the south. As sea level rose and larger and larger tides developed, the surface waters of the Gulf cooled and the warm temperate species were increasingly restricted in their range within the Gulf. The Gulf of Maine populations of several species became disjunct from the main population centers in the mid-Atlantic region. The process has continued until recent times with the result that groupings of Virginian species are now limited to isolated pockets, usually near the heads of estuaries, where summer water temperatures still reach levels sufficient for the reproduction of these species with southern affinities. These pockets are called Virginian refugia and they are largely confined to mid-coast Maine. The most charismatic species of Virginian refugia is the native Eastern oyster *Crassostrea virginica* that presently occurs in only a handful of locations in Maine. Recent videography, however, suggests that the oyster is increasing in abundance. The implications of this relative to climate change and restoration efforts will be discussed.

Levine*, E. R.[1] , and L. Goodman[2], [1] Autonomous Systems Department, NUWC, Newport, RI 02840; [2] Department of Estuarine and Ocean Sciences, SMAST, University of Massachusetts Dartmouth, New Bedford, MA, 027444.

TURBULENCE OBSERVATIONS IN NARRAGANSETT BAY

Narragansett Bay is a weakly stratified estuary, with primarily semi-diurnal tides, and complex geometry. Tidal energy dissipation estimates using mean currents show that bottom effects are concentrated in a few localized areas, near constrictions (Levine and Kenyon, 1975). The first direct turbulence measurements in the Bay (Levine and Lueck, 1999) were made using shear probes and ultra-fast thermistors on a large autonomous underwater vehicle (AUV), during winter. The estimated rate of dissipation of kinetic energy was found to be consistent with the rate of production of turbulence by surface wind forcing and bottom stress. Subsequently, direct turbulence measurements from a small AUV were made, under strongly stratified conditions in late summer, (Goodman et al, 2006). The turbulent kinetic energy budget was found to closed when the buoyancy Reynolds number exceeds 20, the threshold for the initiation of turbulence under stratified conditions. Also, direct turbulence observations with a towed undulating platform (Ullman and Hebert, 2006), during summer, demonstrated that vertical mixing is enhanced in constrictions in the main channel, at certain tidal phases. Important questions remain unanswered, including the relative importance of surface and bottom forcing, over tidal and annual cycles, as well as and the role of turbulence and mixing in the Bay's ecosystem.

Macfarlane, S.L.

AUTUMN'S GOLD NUGGETS: WASTEWATER MANAGEMENT AND THE SCALLOP CONNECTION

Reversing the effects of nutrient loading has become an important aspect of marine policy. Modeling combined biological and physical parameters gave the Massachusetts Estuary Program tools to establish Total Maximum Daily Loads (TMDLs) of nitrogen for estuaries in the state. An important resource is eelgrass cover as a determinant of water quality. The TMDLs for Pleasant Bay are based on 1950s areal surveys of eelgrass abundance. Since eelgrass is the favored habitat of bay scallops, , and since scallop production has declined precipitously along with eelgrass cover, reversing the trend of nutrient loading may result in greater scallop production. Towns surrounding the bay are developing wastewater management plans to address the nutrient loading. The estuary report specifies the amount of reduction necessary in each sub-embayment to meet the restrictions imposed by the TMDLs. Kettle-hole salt ponds in the upper reaches of the bay need reductions of 50-100%. Local policy states that all residents are part of the problem and should be part of the solution. But residents are nervous about the infrastructure required to effect these reductions and the cost. Pleasant Bay's hydrodynamics is governed by barrier beach dynamics. A new breach occurring in 2007, dramatically changed both physical and biological aspects of bay function and improved water quality, leading to questions of the estuary report conclusions. Amid the controversy, Town Meeting approved moving forward with the planning process, a step interpreted as a positive sign that the residents understand the potential ramifications of inaction and depending on natural barrier beach fluctuations.

Manfredi*, V.[1,2] and K. Oliveira[2]. [1]Massachusetts Division of Marine Fisheries Resource Assessment Project, Quest Center, 1213 Purchase Street 3rd Floor, New Bedford, MA 02740; [2]University of Massachusetts-Dartmouth, Biology Department 285 Old Westport Road, North Dartmouth, MA 02747

YOUNG OF THE YEAR WINTER FLOUNDER DISTRIBUTION AMONG COASTAL AND ESTUARINE HABITATS

Winter flounder are coastal residents that depend on near - shore waters to complete their life cycle. Coastal development damages this environment. Identifying habitats important to this species is necessary. Sites were selected to determine if densities of juvenile winter flounder, *Pseudopleuronectes americanus* (Walbaum 1792), differ between eelgrass - bed edge (*Zostera marina*) and dynamic, sandy substrate both inside and outside a Massachusetts estuary. Sites were sampled monthly to characterize settlement, migrations and possible shifts in habitat use over the first year of life. Representative sites were chosen within the Plymouth Harbor / Kingston Bay / Duxbury Bay (PKD) estuary and outside the PKD inlet in Cape Cod Bay (CCB). Habitats were classified visually along SCUBA transects. Sediment cores and digital quadrat photographs were also collected. Fish collections were accomplished using a 1-meter beam trawl towed on three fixed transects at each site (June 2006 - May 2008). Two-Way ANOVA was used to test for differences in flounder catch between habitats (eelgrass edge vs. sand) and locations (CCB vs. PKD) when flounder were present (July – December 2006 and 2007). A significant interaction between location and habitat was identified. The pattern of dependence between location and habitat effects was synergistic. The effects of habitat and location act together to promote a positive deviation in mean catch. Winter flounder catch was greater in eelgrass edge and sandy habitats within the PKD estuary and lower among comparable habitats in CCB. Post-hoc analysis confirmed that catches were greater within estuarine eelgrass - edge habitat.

Metzler, A.*, M. F. Tlusty, and D. Christie. New England Aquarium Edgerton Research Laboratory, Boston, MA 02110

DIETARY INFLUENCE ON SHELL DISEASE IN JUVENILE LOBSTERS (*Homarus americanus*)

Shell disease in the American lobster, *Homarus americanus*, occurs when chitonlytic bacteria settle on and erode the shell creating lesions, or pits. In recent years, shell disease in lobsters has become more prevalent, causing problems for both the wild lobster population and the lobster fishery. For example, the disease has been linked to difficulties with molting, reproduction, and survivorship. Shell diseased lobsters are also detrimental to the lobster fishery due to a reduced market value. Because of the impact on the fishery, shell disease research has focused primarily on adult lobsters. However, much less is known regarding the effects of the disease on juveniles. Our lab investigated the effects of diet on the presence and prevalence of shell disease in juvenile lobsters. Lab reared juvenile lobsters of various ages were fed different dietary regimens and shell disease progression was monitored. The studies focused on: 1) calcium, which is important in shell structure, 2) astaxanthin, a carotenoid and antioxidant used for shell pigmentation and, 3) various quantities of herring, the primary bait used in lobster traps in Massachusetts. The lobsters were fed once daily, and shell disease progression was monitored using visual and digital photographic analysis. Preliminary results indicate that astaxanthin and calcium can delay onset of disease, while a diet primarily composed of herring may result in increased shell disease severity as well as high mortality rates.

Moore*, G.E.[1], Burdick, D.M.[2], Peter, C.R.[2], and G.L. Chmura[3], [1]Department of Biological Sciences and Jackson Estuarine Laboratory, University of New Hampshire, Durham, NH 03824; [2]Department of Natural Resources and Jackson Estuarine Laboratory, University of New Hampshire, Durham, NH 03824; [3]Global Environmental and Climate Change Centre and McGill University, Montreal, QC.

VALUATION OF ECOSYSTEM SERVICES IN RESTORED SALT MARSHES

The Restoration Performance Index (RPI) is a flexible tool for evaluating monitoring results and has been used to assess restoration performance. In light of budgetary limitations, practitioners are encouraged to demonstrate economic value of restoration activities, which can be critical for continued government support. A commonly used approach is to assess ecosystem services provided through restoration. Although tidal salt marshes were included in the valuation of global ecosystem services by Costanza and colleagues in 1997 and later reviews, the lists of services vary and none have addressed all the ecosystem services that can be attributed to tidal salt marshes. This presentation reviews the ecosystem services attributed to salt marshes and suggests additional services that have been overlooked. We then use the RPI as a basis for calculating benefits of a restoration project based upon the value of ecosystem services. Because the RPI can employ any number of indicators to assess restoration success, we can get estimates based on a variety of data sets. It calculates the proportion to which the indicator has been restored, as compared to one or more reference marshes. By multiplying this proportion times the value of ecosystem services per unit area of reference marsh, the RPI can be used to calculate annual monetary benefits accrued from a restoration project.

Nelson, K., N. Moin, and A. Bernhard* Connecticut College, New London, CT 06320

ARCHAEAL DIVERSITY AND THE PREVALENCE OF CRENARCHAEOTA IN A SALT MARSH

We investigated archaeal diversity in salt marsh sediments from the Connecticut shoreline of Long Island Sound, USA. Archaeal 16S rRNA genes were amplified from surface sediments collected from areas dominated by different marsh vegetation (*Spartina alterniflora* [short and tall forms] and *S. patens*). At all three sites, sequences affiliated with Crenarchaeota dominated (>70%) the clone libraries, but Crenarchaeota composition differed. Group I.1a Crenarchaeota (CGI.1a) were prevalent at two of the three sites, and comprised 60% of the clones at the *S. patens* site. At the *S. alterniflora* (short) site, 88% of the clones affiliated with Marine Benthic Group C, but no CGI.1a clones were recovered. Abundance of CGI.1a 16S rRNA genes, archaeal ammonia monooxygenase genes (*amo*A) and Betaproteobacterial *amo*A genes were quantified by real-time PCR. CGI.1a 16S rRNA genes were most abundant at the *S. patens* site, least abundant at the *S. alterniflora* (short) site, and showed minimal variation over six sampling dates from October 2005 to October 2006. CGI.1a 16S rRNA and archaeal *amo*A genes were positively and significantly correlated, and archaeal *amo*A genes always outnumbered bacterial *amo*A genes. Our data indicate that Crenarchaeota are common members of the archaeal communities in salt marsh sediments, and CGI.1a Crenarchaeota comprise a stable component of some communities and may be important contributors to nitrification in salt marshes.

Peng, X.[1], and A. Giblin [2], [1]Department of Biology, Connecticut College, New London, CT 06320; [2]The Ecosystem Center, Marine Biological Laboratory, Woods Hole, MA 02543.

NITROGEN CYCLING IN SEDIMENTS IN TWO STRETCHES OF THE COONAMESSETT RIVER

Restoration of streams can enhance their ecological services, and nitrogen (N) removal through denitrification is one of the most important ones. Rivers in coastal areas are especially critical in controlling the N entering estuaries. I conducted this study on major N processes in sediments in two stretches of the Coonamessett River, which flows into Nantucket Sound on Cape Cod. One stretch flows through a recently discontinued cranberry bog while the other locates immediately downstream in a natural forest. I characterized and quantified substrates coverage along transects in the river. I used acetylene inhibition method to measure the potential denitrification rates. I monitored the production of nitrate in each substrate after adding ammonium and calculated the potential nitrification rates. I estimated potential rates of dissimilatory nitrate reduction to ammonium (DNRA) by sediment core incubation, ammonium diffusion and stable isotope analysis. The forest stretch of the river had more substrates rich in organic matter than the bog stretch. Potential denitrification rates of substrates in the forest were significantly higher than in the bog. The forest stretch as a whole could potentially denitrify twice as much as the bog stretch. Potential rates of nitrification and DNRA on various substrates were generally higher in the bog than in the forest but rates were not significantly different. This suggests that if restoration could change the substrate composition and increase the labile carbon availability in the bog stretch, the N removal capability should be enhanced, as more N would be denitrified into nitrogen gas rather than conserved in the streams through DNRA.

Pregnall, H. J. Arthur S. May Elementary School, Poughkeepsie, NY 12603

MANATEES AND HUMANS: THE FUTURE OF THE MANATEE RELIES ON US

Manatees and Humans is about how the manatee is important to life and how we can stop them from going extinct. It includes fun facts, such as the average weight and length of manatees. Mainly my poster is to make people aware of why we must save these beloved creatures. They live mostly in Florida, in coastal shallow places with lots of yummy sea grass. But sadly, manatees are in danger because of boat propellers. The boats cannot see the manatees, which hover near the surface, and drive right over them, tangling, scraping, and cutting them. Most of them don't make it. Others are seriously injured. This is why we need to inform people why we should protect these animals.

Shields, T. Massachusetts Division of Marine Fisheries, Gloucester, MA 01930

RESTORATION AND ENHANCEMENT OF SOFTSHELL CLAM (*MYA ARENARIA*) POPULATIONS IN BOSTON HARBOR, MASSACHUSETTS, USA

The Massachusetts Division of Marine Fisheries (DMF) recently initiated a multi-year restoration program to supplement diminished populations of softshell clams (*Mya arenaria*) in Boston Harbor. The collaborative effort involves the Northeastern Massachusetts Aquaculture Center (NEMAC), five municipalities and commercial shellfishers. In 2006 the study team seeded one million hatchery reared juvenile clams within five enhancement sites on tidal flats in Quincy, Weymouth and Hingham. During this pilot scaled year, the restoration team developed a better understanding of the importance of seed size. Most of the small clams (5-7mm SL) that were out-planted did not survive. Larger clams (9.7 to 15.3mm SL) that were seeded at the Hingham Bathing Beach site had much better survival rates. After 90 weeks of growth, all 13 enhancement plots at this site supported clam densities between 15 and 25 clams/ft2. DMF and its partners carried out a second year of softshell clam enhancement in 2007. The number of municipalities

was expanded to five with the inclusion of Hull and Winthrop. During summer 2007, approximately 870,000 juvenile clams (10.5 to 16.8 mm SL) were planted at a density of 30 clams/ft2 within eight enhancement sites. Clam survival and growth varied among sites and within a site. Preliminary analysis of data collected in fall/winter 2008 indicate that percent legal sized clams ($\geq$ 50.8 mm SL) within the plots ranged between 43 and 74 percent, and that high to moderate clam survival was observed in 80 percent of the plots seeded in 2007. Variability in clam survival is partially attributable to specific site characteristics including sediment type and beach kinetics.

Smith, Stephen M., National Park Service, Cape Cod National Seashore, 99 Marconi Site Road, Wellfleet, MA 02667

THE IMPORTANCE OF TEMPERATURE REGIME IN TIDAL RESTORATION: A CASE STUDY OF PERIWINKLES (LITTORINA LITTOREA) AND MACROALGAE IN A PARTIALLY-RESTORED SALT MARSH LAGOON

East Harbor (Truro, Massachusetts) is a tidally-restricted salt marsh lagoon that has undergone partial restoration since 2002. After re-introducing seawater to the system following 140 years of impoundment, remarkable transformations in plant and animal communities have occurred. While a host of marine fish, crustaceans, and benthic invertebrates have become established throughout the system, an important herbivore, Littorina littorea (common periwinkle), has not. Although having successfully colonized the main tidal creek that now connects the system with Cape Cod Bay, it is absent throughout the open lagoon where in the past several years macroalgae has proliferated. Nuisance levels of macroalgae biomass has caused a number of problems including losses of seagrass and bottom-water anoxia, the latter being a suspected cause of shellfish dieoffs. Thermal tolerance bioassays using individuals from the tidal creek suggest a lethal high-temperature limit of ~27-30°C and data from temperature loggers show that this threshold is exceeded in many parts of the lagoon during July-August. Moreover, there is a well-defined spatial gradient in temperature that corresponds with the population distribution of L. littorea. Further enhancement of tidal exchange could lower water temperatures throughout East Harbor and allow this species to greatly expand its range. Grazing experiments suggest that colonization of the lagoon could significantly reduce the extent of macroalgae biomass there. This study suggests that L. littorea could be used as an indicator species during tidal restoration as well as highlighting the importance of restoring temperature regimes for the functional recovery of these systems.

Swanson*, J.L. [1], M.J. James-Pirri[2], C.T. Roman[3], H. Ginsburg[4], J.F. Heltshe[1], [1]Department of Computer Science and Statisics, University of Rhode Island, Kingston, RI 02881; [2]Graduate School of Oceanography, University of Rhode Island, Narragansett, RI 02882; [3]National Park Service, University of Rhode Island, Narragansett, RI 02882; [4]USGS Patuxent Wildlife Research Center, University of Rhode Island, Kingston, RI. 02881.

DEVELOPING THRESHOLDS FOR MANAGEMENT OF SALT MARSH ECOSYSTEMS USING NEKTON AND VEGETATION DATA

Long term salt marsh sampling has been conducted by the National Park Service, U.S. Fish and Wildlife and others at coastal units from Maine to Virginia. Nekton (free swimming fish and crustaceans) and vegetation data were collected using established National Park Service protocols at 77 marshes and the resulting database contains species densities in 7,938 individual nekton samples (enclosure traps) and vegetation percent cover from 4,220 1-m^2 sample plots. The data were analyzed using multivariate statistical techniques to identify patterns in community structure related to level of

hydrologic impact (e.g. Open Marsh Water Management, tidal restriction, etc.) and degree of watershed development. Analyses show shifts in nekton guild structure along a gradient of watershed population development. Vegetation species richness differed between marshes with different levels of hydrologic impacts. Eventual goals of analysis include development of thresholds to assist in management of these important ecosystems.

Taylor, D. I. Massachusetts Water Resources Authority, 100 First Ave, Charlestown Navy Yard, Boston, MA 02129

THE BOSTON HARBOR PROJECT, AND LARGE DECREASES IN EUTROPHICATION-RELATED MATERIALS TO BOSTON HARBOR

The purpose of this paper is to document the changes in the loadings of eutrophication-related materials to Boston Harbor over the course of the Boston Harbor (BHP). Before the BHP the loadings of total nitrogen (TP) and total phosphorus (TP) to the harbor were among the highest reported for bays or estuaries in the USA. Over the course of the Project, the total loadings of TN, TP, total suspended solids (TSS) and particulate organic carbon (POC) decreased by 80% to 95%. Total freshwater inflows decreased by 44%. Reductions in wastewater loadings brought about by the BHP contributed 96% to 100% of the decreases in the TN, TP, TSS and POC loadings. They contributed 68% of the decreases in the freshwater inflows. The TSS:POC and TN:TP ratios of the total loadings to the harbor increased throught the Project.

Turner*, S., T. Shields, Massachusetts Division of Marine Fisheries, Gloucester MA 01930

BOSTON HARBOR SHELLFISH ENHANCEMENT PROJECT

In April 2006 the Massachusetts Division of Marine Fisheries (DMF) initiated a multi-year program to restore and enhance existing populations of softshell clams (*Mya arenaria*) in five Boston Harbor communities through cooperative programs with local municipalities, commercial shellfishers and Salem State Northeast Massachusetts Aquaculture Center (NEMAC). Between 5 June and 5 September 2007, approximately 870,000 clams that averaged between 10.5 to 16.8 mm SL (Shell Length) were stocked within 49 plots in Hull, Winthrop, Quincy, Weymouth and Hingham. At each site, a total of 108,000 clams were planted in six 50 x12 ft. plots at an approximate density of 30 clams/ft2. Each seeded area was covered with 0.25 inch mesh, extruded plastic netting (52 x 14 ft) to exclude predators. Predator exclusion netting was secured in position by a 6-12 inch deep trench dug along the perimeter of each seeded area and back-filled with sediment that provided a 600 ft2 netted refuge (50 x 12 ft). All nets were removed from the tidal flats before winter ice-up. Field data collected in spring 2008 is used to describe clam growth and survival within eight Boston Harbor enhancement sites. Due to the extended seeding period (June to September) there was a distinct difference in growth periods at each site. The best clam growth was observed at sites where larger clams were seeded early in the summer. High to moderate clam densities were observed at all eight of the enhancement sites. Low clam densities were observed in only 5 of the 49 experimental plots seeded in 2007. Physical characteristics (sediment type and beach kinetics) at two of these sites were most likely the cause of low clam survival.

Wigand*, C.[1], E. Davey[1], R. Johnson[1], M. Stolt[2], M. Holt[3], R. Tien[1], and L. Gamez[1], [1]US EPA NHEERL, Atlantic Ecology Division, Narragansett, RI 02882; [2]University of Rhode Island, Kingston, RI.; [3]US Fish and Wildlife Service, Red Bluff Fish & Wildlife Office, Red Bluff, CA 96080.

SOIL RESPIRATION AND BELOWGROUND CARBON STORES AMONG SALT MARSHES ALONG A GRADIENT OF INCREASING WATERSHED NITROGEN LOADINGS IN SOUTHERN NEW ENGLAND

Coastal salt marshes are ecosystems located between the uplands and sea, and because of their location are subject to increasing watershed nutrient loadings and rising sea levels. Residential development along the coast is intense, and there is a significant relationship between residential development and watershed nitrogen (N) loadings in Narragansett Bay, RI. We examined soil respiration and belowground carbon stores (roots, rhizomes, percent organic matter, carbon and nitrogen) among salt marshes along a gradient of increasing watershed N loadings. Soil respiration significantly increased in Narragansett Bay salt marshes with increasing watershed N loadings. There was also a significant increase of detritivores in the low marsh soils with high watershed N loadings and high soil respiration rates. Belowground root and rhizome stores in the high marsh, and surface layer percent carbon and nitrogen in the low marsh, decreased with increasing soil respiration, suggesting that nutrient enrichment contributes to increased turnover of belowground macro-organic matter. Similar responses of increased soil respiration rates and decreased macro-organic matter stores were found in marshes in Jamaica Bay, NY that are currently experiencing major areal losses as high as 45 acres per year. In general, the marshes receiving low watershed N loadings had lower soil respiration rates, greater belowground macro-organic matter, and less detritivores. Rising sea levels will cause an increase in the frequency and duration of flooding which will likely exacerbate the effects of N enrichment in organic-rich salt marshes. Losses of belowground macro-organic matter may result in marsh soils more prone to subsidence and erosion.

Wilson*, K. A.[1], L. Judd Jones[2], A.O. Pearson[2]. [1]Department of Environmental Science, University of Southern Maine, Gorham, Maine; [2]Department of Biology, University of Southern Maine, Portland, Maine

UNUSUAL PATTERNS OF NATURAL RECRUITMENT OF SALT MARSH PLANTS IN A SALT MARSH UNDERGOING HYDROLOGICAL RESTORATION

Salt marsh restorations have shown plant recruitment limitation due to dispersal constraints and harsh substrate conditions. We describe unusual, and usual, patterns of natural plant recruitment at a 90 ha site in Newcastle, Maine, and relate those patterns to the somewhat unique conditions on the marsh. Restoration occurred in 2005 when a berm retaining the shallow freshwaters of Sherman Lake was breached during a large rain event, draining the lake and revealing peats and tidal creeks that had been isolated from the ocean in 1934. In the years since, tidal inundation has slowly increased. In permanent plots monitored since 2006, vegetation has shifted from primarily freshwater species in 2006 to brackish and salt marsh species in 2008. The exceptions were *Juncus gerardii* and *Schoenoplectus maritimus* which both sprouted from seed in 2006 throughout the marsh, regardless of tidal inundation patterns. Over time, salt marsh species have become more prevalent in the far reaches of the marsh. In the fall of 2007, non-native stands of *Phragmites australis* were first found on the marsh, and expanded throughout the marsh in 2008. Final construction at the marsh inlet completed in Fall 2008 is expected to result in further vegetation change in 2009 and beyond.

Wilson*, Kristin R.[1], Joseph T. Kelley[2], Daniel F. Belknap[2], Benjamin R. Tanner[3], [1]Program in Ecology and Environmental Sciences, University of Maine, Orono, ME 04469; [2]Department of Earth Sciences, University of Maine, Orono, ME 04469; [3]Department of Geosciences and Natural Resources, Western Carolina University, Cullowhee, NC 28723

NEW SALT POOL DESCRIPTION WARRANTS REINTERPRETATION OF THE STRATIGRAPHIC RECORD OF MAINE SALT MARSHES

Salt pools are shallow, water-filled depressions common to many north-temperate salt marshes. On-going work seeks to characterize Maine salt pools, which previous stratigraphic work has generally neglected. This study involves pools from five salt marshes distributed S-N along Maine's coast (Ogunquit, Brunswick, Gouldsboro, Addison, and Lubec), combining field surveys with spatial analyses and Dutch coring. In the stratigraphic record, pool sediment is characterized by dark gray muddy material with high water content, low C:N ratios (6.79-9.13), high total organic carbon (2.21-9.18%), and unique micro- and macro-fossils (*e.g., Ruppia maritima* drupes, *Quercus* leaf fragments, and *Hydrobia totteni* gastropods). Our work indicates that most pools in Maine are secondary and dynamic features (84% of cored pools; n = 19), rather than primary, relict landforms. Time-series of aerial photographs indicate that pools alter their shape and size over decadal time frames. The dynamic exchange between pools and tidal creeks is one geographically universal mechanism for substantial surficial transformations. Pb-210 analyses of paired cores in high-marsh and re-vegetated pools indicate that pools may drain, rapidly fill in, and re-vegetate. This process may be one by which north-temperate salt marshes may achieve a surficial, dynamic equilibrium. Our findings suggest that previous studies likely misinterpreted salt pool deposits, resulting in false understanding of past salt marsh environments and their relationship to relative sea-level fluctuations. Recognition of the salt pool signature and better understanding of the dynamic pool cycle warrant a reinterpretation of these reports.

Windecker, L.A., and Nixon, S.W. Graduate School of Oceanography, University of Rhode Island, South Ferry Road, Narragansett, RI 02882

THE PHYTOPLANKTON OF MID-NARRAGANSETT BAY, 1999-2008: QUALITY CONTROL AND DATA ANALYSIS

The Graduate School of Oceanography (GSO) at the University of Rhode Island has sponsored weekly monitoring of the mid-Narragansett Bay plankton community along with associated environmental parameters since 1999. A major component of this program is the census of phytoplankton species composition and abundance. This is achieved in the following two ways: a) a qualitative species list derived from a surface net tow, and (b) a quantitative cell count in a Sedgwick-Rafter chamber comprised of a combined surface and bottom whole water sample. Despite the public availability of these data, they have not been assessed for quality nor analyzed to any substantial degree. Because nine GSO graduate research assistants of varying abilities have contributed to the data collection in almost as many years, the need for a data quality assessment is understandable. This is being evaluated in a variety of ways, including comparing original data sheets with the digital database, consulting preserved slides containing diatoms and thecate dinoflagellates derived from the qualitative tow, and by graphing each taxa relative to time to identify any inconsistencies. These data reveal approximately 150 taxa present over the course of the collection period. Of these, *Skeletonema spp*., the most abundant group during the latter half of the last century, remain the most abundant. However, the overall decline in this group after 1980, as reported by others, continues. Additionally, some species that were less common two decades prior

to 1980, such as *Eucampia zodiacus*, have become much more abundant while once common species like *Detonula convervacea* and *Heterosigma akashiwo* have continued a significant decline.

Wood*, M, and C. Cuomo, Department of Environmental Science, University of New Haven, 300 Boston Post Road, West Haven, CT 06516

THERMAL TOLERANCE OF THE INVASIVE TUNICATE, *STYELA CLAVA*

An invasive species is recognized as an organism that displaces native species. *Styela clava*, native to the Pacific Northwest, was first noticed in Long Island Sound in the early 1970's but was not considered a problem invasive until the late 1990's. Thermal tolerance of *Styela clava* was determined in the fall of 2008. *Styela* were collected from New London, CT and transported to the lab where they were glued onto platforms and fed daily. After acclimation, water temperature was raised 3°C. Siphon contraction was checked every six hours for the first 24 hours, once a day for the next three days, and the temperature was raised again on the fifth day. This process was repeated until all animals died. The entire experiment was repeated with cold shock and gradual temperature decreases. Preliminary results show that *Styela clava* is able to withstand temperatures from 3°C to 31°C. Over 80% of the tunicates survived until the temperature exceeded 27°C, at which point a significant die-off occurred. During the cold trial only two tunicates died; the only noticeable effects seen were lethargy and decreased siphon contraction. Given the wide range of temperatures withstood, mature *Styela clava* are expected to thrive in waters outside of its current US range. Continued research will focus on larval tolerance of extreme temperatures. If larvae are able to tolerate similar temperatures, this organism will likely disperse south towards the Carolinas and further north into the Arctic.