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ABSTRACTS

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Wells, Maine

Armstrong. M. P. and J. Guy, Zoology Department, University of New Hampshire, Durham, NH 03824. SEASONAL AND DIEL USE OF A LOW SALINITY MARSH CREEK BY FISHES IN A NORTH TEMPERATE ESTUARY.

Estuarine salt marshes are widely recognized as important nursery areas for estuarine and marine fishes. This conclusion has been drawn primarily from work done in sub-tropical and south temperate estuaries, and extrapolated to north temperate/boreal systems. Northern estuaries differ considerably from their southern counterparts in many aspects. It is possible the nursery function of higher latitude estuaries may be overstated or need redefining especially for marine species. The objectives of this study were to determine the diversity, numbers, size distributions, and diel activity of fishes present at particular times of the year in a Gulf of Maine oligomesohaline marsh creek. Hoop net samples were collected bi-monthly during May-Nov., 1990. in upper Great Bay estuary, NH. Resident species dominated the collections, comprising >90% of total fish collected. Marine species, including anadromous forms, were poorly represented (4.6%). Y-O-Y tomcod, white perch, mummichog, river herring, and silversides occurred as pulses throughout the sampling period. Few species showed significant diel differences in abundance.

Berounsky, V.M. and S.W. Nixon, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI 02882-1197. REGULATION & ROLE OF NITRIFICATION IN NARRAGANSETT BAY.

Rates of pelagic nitrification, the bacterially-mediated oxidation of ammonium to nitrite and then to nitate, were measured over one or more annual cycles in Narragansett Bay, RI using N-Serve--sensitive [C^{14}] bicarbonate uptake, Rates were always higher at the ammonium-rich Providence River estuary site (004 - 11.2 μmol l^{-1} day^{-1}) than at either the nutrient-poor lower N4rrag~nsett Bay site (0.02 - 0.98 μmol $1^{-1}day^{-1}$) or the freshwater Blackstone River site (0.04 - 1.7 μmol $l^{-1}day^{-1}$). Temperature was the most important variable regulating the annual cycle of nitrification but a strong, exponential relationship with ammonium (r = 0.81) was found for summer nitrification rates. In lower Narragansett Bay, nitrification contributed 55% of the NO_2^- and NO_3^- entering annually, and was the major source during spring and summer. High summer rates of nitrification could support much of the phytoplankton uptake of NO_2^- and NO_3^-. Elevated levels of NO_3^- in the fall resulted from a decline in phytoplankton uptake of NO_3^- and a continuing rate of nitrification, and were not dependent on river inputs. In the Providence River estuary, major annual inputs of NO_2^- and NO_3^- were from rivers (54%), nitrification (28%), and water from the lower bay (11%). Nitrification dominated in the summer, other sources dominated other sea-sons. Mixing diagrams of salinity and NO_2^- also provide evidence for summer net production in the upper water column. The summer rates in the Providence River estuary could be responsible for about 5 to 20% of the total oxygen consumption and may be important for nitric and nitrous oxides production.

Burdick, D. M. and J. W. H. Dacey. Jackson Estuarine Laboratory and the Department of Natural resources, University of New Hampshire, Durham, NH 03824; and Biology Department, Woods Hole Oceanographic Institution, Woods Hole, MA 02543. THE POTENTIAL ROLE OF DMSP AS AN OSMOPROTECTANT IN *SPARTINA*.

Although it is not considered as an osmotica in *Spartina,* dimethylsufoniopropionate (DMSP) is a sulfur-containing compound that can accumulate to concentrations that exceed nitrogen-containing solutes that have been established as osmotica (Proline, Betaine). Since production of salt marsh grasses has been shown to be nitrogen limited, an osmotic solute that does not contain nitrogen would provide an important alternative for salt marsh plants. Eight genotypes of *Spartina* were grown in tanks flooded with 0, 250 and 500 mM salinity under high nitrogen levels in the greenhouse. Betaine and Proline both increased with salinity, but DMSP did not. DMSP concentration did vary by species, however. In a salt marsh with fertilized and control areas of *S. alterniflora* that had been maintained over twenty years, concentrations of Proline, Betaine, and DMSP varied strongly with fertilization, while the sum of the solutes remained similar for both treatments. Thus DMSP appears to have a role in osmotic balance, but it clearly behaves differently than Betaine and Proline.

Burn, P., Moore, R., Rosol, M., Olsson, A., and Barrett, S. Suffolk University and Massachusetts General Hospital, Boston, MA 02114. CAN WE DEMONSTRATE DIFFERENCES IN BOSTON HARBOR FLOUNDER LIVER FUNCTION IN VIVO?

Tc-99m radiolabelled diisopropylacetanilide iminodiacetic acid (disofenin) is a small (MW=348 D), lipophilic molecule used to assess hepatobiliary function in humans. The molecule is injected intravenously, extracted from the blood by hepatocytes, and then excreted into the bile. Rates for both extraction and excretion can be determined in vivo using the scintillation camera. The applicability of this technique for assessing liver function in winter flounder has recently been established. We are applying it to compare the rates of liver treatment of disofenin in flounder from a contaminated environment (Boston Harbor) and from a control site. Preliminary results will be presented.

Carlson, Noel C. and Frederick T. Short, Department of Natural Resources and Jackson Estuarine Laboratory, University of New Hampshire, Durham, NH 03824. USE OF BIOTURBATOR EXCLUSION DEVICES TO PREVENT LOSSES OF THE TRANSPLANTED SEAGRASS, *ZOSTERA MARINA* L.

The New Hampshire Port Authority, Portsmouth, New Hampshire, is sponsoring a pilot transplanting project of the seagrass, *Zostera marina L.* as a first step toward mitigation for potential losses of seagrass due to a proposed expansion of the port. Eelgrass transplanting commenced in September, 1992, and continued through mid October. Eelgrass was planted in 3 m^2 grids on 0.5 m centers using two individual terminal and associated lateral shoots as each planting unit. Initially, three plots of eelgrass were planted at four sites. One of the three plots at each site was protected with a cage of gill netting to eliminate destruction by green crabs and horseshoe crabs. Within 14-20 days of transplanting, all unprotected transplants were uprooted, plowed under, or shredded at the meristem at all four sites, while survivorship within the cages averaged 90 to 95 percent. After the initial losses, gill net cages were erected around two new plots at each site, and these plots were transplanted with eelgrass from an additional two different donor populations (one population in each of three cages at each of the four sites). Transplants will be monitored throughout the winter and survivorship will be measured in spring 1993.

Nitrogen Loading To Massachusetts Bay. Jerome J. Cura and Jonathan Freshman. Menzie-Cura & Associates, Inc. Chelmsford, MA

Using an estimated 300 grams carbon/squire meter as the annual primary production in Massachusetts Bay and assuming Redfield ratios, the calculated annual nitrogen demand is 190,000 metric tons. We provide estimates of the total annual nitrogen load Ito Mass Bay which accounts for only 49% of this calculated bay-wide nitrogen demand. This discrepancy between nitrogen demand and external loading of new nitrogen is commonly observed in coastal waters, and is compensated for by regenerated nitrogen which may range as high as 72% of total nitrogen. Import of nitrogen from Gulf Of Maine to Massachusetts Bay is the largest estimated source of nitrogen and accounts for approximately 74% of the total annual nitrogen load (37% of demand). As much as 16% of this coastal water source may derive from the Merrimack River. The various NPDES discharges, the next largest aggregate source, accounts for 17.5% of the total annual load. The MWRA discharge in Boston Harbor accounts for most of this with 13% of the total annual nitrogen load (6.5% of the demand). The loading from groundwater discharging from Cape Cod is an insignficant source bay-wide but may have implications in small coastal embayments.

Elvin, D., Vermont Information Systems, Shelburne, VT 05482. PRELIMINARY REPORT: NSF WORKSHOP ON "VISUAL DATABASE SYSTEMS FOR THE MARINE SCIENCES. "

There is an rapidly increasing need by the marine biology community to manage visual information about habitats and organisms. The problem should be treated on a regional basis as a managed visual information resource, and should be coordinated with other international efforts. The technological trends are towards dispersed, federated image databases with emphasis on quality documentation of visual data and certification of image interpretation. Levels of interoperability within regional networks and a consistent descriptive language were also discussed. Such a comprehensive visual information resource has applications for research, teaching, environmental monitoring and management, and public discourse concerning the same regional knowledge and issues.

Foreman, Kenneth H.[1], C. D'Avanzo[2]and I. Valiela[1]. [1]Boston University Marine Program, M.B.L Woods Hole MA 02543, and [2]Hampshire College, Dept of Natural Science, Amherst, MA 01002. PHYTOPLANKTON AND TOTAL SYSTEM PRODUCTION IN SUBESTUARIES OF WAQUOIT BAY, MA SUBJECT TO DIFFERENT LEVELS OF N-LOADING.

Waquoit Bay is a shallow (mean depth ~1 m, max depth 2.7 m) system of embayments and groundwater fed tributaries covering about 630 ha. The watershed can be divided into 7 subwatersheds, each of which empties into a different "subestuary" of the Bay. These subwatersheds contain different densities of houses which input nutrients to the aquifer via septic tanks, and, as a result, their receiving waters experience different levels of nutrient loading. In the past 20 years, Waquoit Bay has become progressively eutrophied by residential development. One symptom of eutrophication has been replacement of once abundant eelgrass beds by extensive mats of drift macroalgae, mainly *Cladophora tikvahiae.* The algal mats compete with phytoplankton for regenerated nutrients and influence the seasonal pattern and amount of phytoplankton production. We have compared nutrient dynamics, phytoplankton and total system production in 3 subestuaries of the Bay, the heavily N-loaded Childs River, the moderately loaded Quashnet River and the relatively pristine Sage Lot Pond systems. Total system production in these systems, determined by measuring diet changes in free water oxygen concentration, averages about 650-700 g C m^{-2} y^{-1} in Childs and 200-250 g C m^{-2} y^{-1} Sage Lot, while phytoplankton production averages about 250-300 g C m^{-2} y^{-1} in Childs and 75-100 g C m^{-2} y^{-1} in Sage Lot. Differences in the partitioning' between phytoplankton and macroalgal productivity is one response to changes in N-loading.

Franz, D.R., Biol. Department, Brooklyn College CUNY, Brooklyn, NY 11210. GROWTH, DENSITY AND BIOMASS VARIABILITY AMONG RIBBED MUSSEL POPULATIONS IN JAMAICA BAY, NY.

Growth rates, body weight, density and biomass of Geukensia demissa were determined at 10 Spartina alterniflora marsh flat sites. Cumulative growth and annual growth increments were lower at sites within the central Bay. Local variability both in size at Ring-1 and size-specific annual growth rates probably account for variability in cumulative length. Congruence in age structure was observed among neighboring sites in some areas of the Bay. Length-specific dry body weights were lower in the central Bay. Mussel densities were greater within Jamaica Bay than at most other locations and estimated biomass values were lower. Growth rates within Jamaica Bay were lower than other northeastern American populations. Four hypotheses are discussed which may account for observed Geukensia, growth rates in Jamaica Bay.

Giblin, A.E., C.S. Hopkinson, J. Tucker, The Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA, 02543. NITROGEN CYCLING IN SEDIMENTS FROM BOSTON HARBOR.

For the last year we have been measuring oxygen uptake, and carbon dioxide, nitrogen and phosphorus release, from sediments taken from Boston Harbor. Measurements were made in September, April, May, June and August. We have used the ratio of carbon dioxide/dissolved inorganic nitrogen release to calculate the amount of nitrogen lost via denitrification. We assumed decomposing matter in the sediments has a C/N ratio of 6.625, which would correspond to the Redfield ratio of 106C/16N. Using the carbon dioxide data we found that "missing" nitrogen ranged from 0.1-3.6 mmol/m2/d. While these denitrification rates represent a substantial loss when compared to the nitrogen flux from the sediments, dentrification removes only a small fraction of the 24 mmol/m2/d of nitrogen which enter Boston Harbor.

Jones, S.H. and K.R. O'Neill. Jackson Estuarine Laboratory, University of New Hampshire, Durham, NH. 03824. INCIDENCE AND IMPLICATIONS OF *VIBRIO VULNIFICUS* IN THE GREAT BAY ESTUARY OF MAINE AND NEW HAMPSHIRE.

Vibrio vulnificus, a normal inhabitant of estuaries, is of concern because it can be a potent human pathogen, causing septicemia, wound infections, and gastrointestinal disease in susceptible hosts. Since May, 1989, samples of shellfish and water collected from sites throughout the Great Bay estuary and surrounding watersheds have been analyzed for the presence of *V. vulnificus.* Typically, its presence could not be detected until early July or after mid October at all sites. Relatively high levels were routinely detected between July and October in oysters and water from the Squamscott, Oyster, Salmon Falls, and Piscataqua rivers. *V. vulnificus* was only rarely detected in Great Bay, and never in Spinney Creek. There was a strong correlation between temperature, salinity, and the presence of *V. vulnificus* in water and oysters. However, other factors appear to influence its presence in certain areas of the estuary. The public health implications of its incidence in Northern New England and the significance of its spatially and temporally heterogeneous distribution in Great Bay estuary will be discussed.

Kane, S.B., Gallagher, E.D. and A.E. McElroy, Environmental Sciences Program, University of Massachusetts, Boston, MA. 02125. BIOTRANSFORMATION AND ELIMINATION OF BENZO[A]PYRENE IN THREE SPECIES OF POLYCHAETES.

Polychaete worms inhabiting polluted sediments may be exposed to polycyclic aromatic hydrocarbons (PAHs), such as benzo[a]pyrene (BaP). In many organisms, PAHs are inducers of cytochrome P450, an enzyme that transforms aromatic compounds to polar metabolites. The goal of this study was to examine whether P450-mediated metabolism of BaP was inducible in three species, Nereis diversicolor, Leitoscoloplos fragilis, and Scolecolepides viridis. Worms collected from clean or polluted sites were exposed to trace quantities of [^{3}H]-BaP in sediment, with or without 3-methylcholanthrene, a potent inducer of P450 activity. Organisms from polluted sites or that had been exposed to the inducer in the lab, did not show notable increases in biotransformation of BaP, suggesting that P450 activity was not induced. There were, however, significant differences between species in their constitutive abilities to transform and eliminate BaP.

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

TRACE METAL CONCENTRATIONS IN THE SEDIMENTS OF MID-COAST MAINE

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

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

Loder, T. C. III and S. Becker, EOS, University of New Hampshire, Durham, NH 03824. NUTRIENT DEEP DOINGS WEST OF CAPE COD.

During the Massachusetts Bays sampling program relatively high nutrient concentrations were found in the subpyenocline shallow waters of the eastern and central areas of Cape Cod Bay during July and October, 1990. During July, silicate values were higher (211.tM) then anywhere else in Massachusetts Bays during that time, while phosphate values (1.4.tM) were also very high. At several stations ammonium values were high while nitrate values were lower than concentrations observed at other locations in Massachusetts Bays. Nutrient ratios based on averaged inventoried nutrient data for Cape Cod Bay changed significantly from spring to summer. The DIN(dissolved inorganic nitrogen)/SiO4 ratio was high in April 1990 (1.22) and March 1991 (1.37) and very low in July (0.39) and October 1990 (0.44), while the SiO_4/PO_4 ratio was high in July (13.6) and October 1990 (1 2.0) and lowest in March 1991 (3.88). These ratios appear to be the result of relatively high concentrations of silicate and phosphate compared to DIN in the water column during summer and fall months. This apparent loss of nitrogen may be explained by denitrification, whose rates based on the relative loss of DIN during July range from 77 to 883 mmol N/m^2/year. Speculations regarding the origins of these deep doings and their impact on nutrient cycling in Cape Cod Bay will be presented.

Potts, M.S., Dept. of Zoology, University of New Hampshire, Durham, NH 03824. EFFECTS OF HEMATOPOIETIC NEOPLASIA ON THE SOFT-SHELL CLAM KIDNEY

The soft-shell clam, *Mya arenaria,* is susceptible to Hematopoietic neoplasia (Hn), a disease in which atypical cells invade the blood and connective tissue of the clam's circulatory, digestive, reproductive and excretory systems. In this study disease effects on kidney function were investigated in Hn and normal clams using techniques of nuclear medicine. The radiopharmaceutical, Tc-99m-disofenin, an agent which localizes in the clam kidney, was injected into the clam's circulatory system at the anterior adductor muscle. Accumulation and excretion of this agent were determined through scintigraphy, gamma well counting and autoradiography. At 15-18°C, Tc-99m-disofenin localized within the clam kidney within 1 hour and was found primarily within this organ by 3 hours. By 7 hrs, 60% of the disofenin within the clam had accumulated in the kidney. Examination of the tissue through autoradiography and biodistribution data confirm that disofenin was differentially concentrated within the kidney tissue. Whole body counts indicate that 15% of the agent was excreted from the clam's system over 7 hrs. No conclusive differences in kidney accumulation or whole body excretion of disofenin were evident between normal and Hn clams. While Hn cells increasingly invade the clam's connective tissue, the data suggest that there is little or no change in clam kidney function, and that the kidney may not be as heavily impacted by Hn as other organs.

Short, F.T. and D.M. Burdick. Jackson Estuarine Laboratory and the Department of Natural Resources, University of New Hampshire, Durham, NH 03824. RECOVERY OF EELGRASS, *ZOSTERA MARINA,* IN THE GREAT BAY ESTUARY: SURVIVING THE WASTING DISEASE.

Aerial surveys made in the Great Bay Estuary between 1984 and 1992 showed precipitous declines from the early 1980s into 1989 as a result of disease-induced plant death. Eelgrass cover in July, 1989 may have approached the all time minimum eelgrass abundance for Great Bay in the 1930s when it was estimated that over 90% of the eelgrass on the East Coast of the United States were destroyed.

During the mid 1980s, while eelgrass populations were declining from wasting disease, we observed an increase in sexual reproduction among the surviving eelgrass populations. The result of this sexual response to the disease stress was a greater production of eelgrass seeds and increased reestablishment of eelgrass beds in the late 1980s. From July to October 1989, the area of eelgrass coverage nearly quadrupled. In 1990, recolonization by seedlings had reestablished eelgrass beds in many areas where no eelgrass had been found for the past decade. By the summer of 1991, eelgrass distribution within Great **Bay** was greater than its distribution in 1984, when it was first discovered that the declines were the result of disease activity. Thus, as the result of a complex interaction of environmental and physiological factors, eelgrass has reestablished its previous spatial distribution within Great **Bay** in the face of continuing losses from the eelgrass wasting disease.

Silvio Pantoja and Cindy Lee, MSRC, State University of New York at Stony Brook, NY 11794 REMOVAL OF AMINO ACIDS FROM SEAWATER BY CELL-SURFACE OXIDATIVE DEAMINATION MEASURED USING FLUORESCENT MOLECULAR ANALOGS.

Cell-surface oxidative deamination of amino acids has been recently reported by Palenik and Morel in certain phytoplankton species grown in laboratory culture. This novel pathway was investigated in natural waters by measuring the disappearance of a synthesized fluorescent analog of the amino acid lysine and observing the production of its oxidation products. Using this synthetic analog approach, it was found that both bacteria and phytoplankton can oxidatively deaminate amino acids in field samples under certain conditions. For example, oxidation rates were on the order of 9 nM/h during a brown tide bloom in West Neck Bay (a coastal embayment of eastern Long Island). Simultaneous measurements of rates of cell-surface oxidation and heterotrophic uptake of amino acids resulted in similar rates of removal of amino acids from seawater by both mechanisms. This preliminary evidence suggests that oxidative deamination may have been previously overlooked and hence the removal flux of amino acids from seawater underestimated when calculated using ^{14}C-labeled techniques alone.

Wang, Y.H. & J. O'Donnell, Department of Marine Sciences, University of Connecticut, Groton, CT 06340. A NUMERICAL COMPUTING OF ESTUARINE COHESIVE SEDIMENT ENTRAINMENT RATES.

Entrainment rate, in the study of estuarine sedimentation and associated bottom nutrient or toxic material redistribution, is a key to the linking of hydrodynamic circulation models and sediment transport models. Empirical formulations from flume experiments are currently being used in most existing models. However, in realistic, field measurements of entrainment rate would be preferred, but are difficult to obtain. A one dimensional(vertical), two-layer, inverse model, using *in-situ* measured time series of current velocity and sediment concentration as interior boundary conditions, has been developed to simulate the sediment settling and mixing processes. This model allows estimation of the exchange flux of near bottom sediment. The eddy diffusivity is calculated using the Mellor & Yamada (1974)'s level II turbulence closure scheme. Applications in Long Island Sound show good agreement with measurcd profiles of temperature & sediment concentration.