

**NEW ENGLAND ESTUARINE RESEARCH SOCIETY**

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**ABSTRACTS**

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## IS THE TAXONOMIC TERM SPIONID ECOLOGICALLY MISLEADING?

Spionid polychaetes are widespread and abundant species of estuarine macrobenthic communities. Some benthic indices suggest that the presence of dense populations of spionids (as a group) indicates that the environment in which they are found may be stressed. *Polydora cornuta* and *Streblospio benedicti*, two of the most common genera found in New England estuarine habitats, have different feeding morphology, feeding behavior, and possibly different evolutionary histories. Our phylogenetic analyses, which included adult, larval, and reproductive characters, suggest that *Streblospio* and *Polydora* are in distinct clades that do not share a recent common ancestor. *Polydora* falls within the traditional "Spioninae" Glade which includes the type genus *Spio*. *Streblospio* falls within the *Prionospio* Glade, separate from all Spioninae. This implies that the Family Spionidae is paraphyletic, and that not all spionids are created equal. Therefore, the use of the term "spionids" as a taxonomic entity may be ecologically misleading.

**Bintz, Joanne C., Scott W. Nixon, Stephen Granger, Susan Sherwood, and Betty Buckley.  
University of Rhode Island Graduate School of Oceanography  
RESPONSE OF EELGRASS (*ZOSTERA MARINA* L.) TO NUTRIENT ENRICHMENT:  
SOME RESULTS OF A SERIES OF MESOCOSM EXPERIMENTS**

Many coastal lagoons in the northeast United States are experiencing increasing amounts of nutrient enrichment as a result of coastal development. A series of ecosystem-level mesocosm experiments performed at the University of Rhode Island documented the response of eelgrass, *Zostera marina* L. to several levels of nitrogen and phosphorus enrichment singly and in combination. When nitrogen and phosphorus were added together ( $N=8 \text{ mmol m}^{-2} \text{ d}^{-1}$  and  $P=1.57 \text{ mmol m}^{-2} \text{ d}^{-1}$ ) phytoplankton blooms were pronounced and persistent. Chlorophyll a concentrations often exceeded  $100 \mu\text{g L}$ . Eelgrass in nitrogen and phosphorus enriched treatments displayed rapid leaf elongation, higher maximum leaf length and, if reduced light conditions persisted, early senescence and death. Enhanced canopy development was not accompanied by proportional rhizome development. When the mesocosm ecosystems were enriched with an N:P molar ratio of 5:1 ( $N=7.8 \text{ mmol m}^{-2} \text{ d}^{-1}$ ,  $P=1.5 \text{ mmol m}^{-2} \text{ d}^{-1}$ ), eelgrass exhibited the ability to incorporate excess water column phosphorus into leaf tissue compared to treatments enriched with an N:P molar ratio of 75:1 ( $N=7.8 \text{ mmol m}^{-2} \text{ d}^{-1}$ ,  $P=0.10 \text{ mmol m}^{-2} \text{ d}^{-1}$ ). During the same experiment, treatments receiving nitrogen loadings of  $7.8 \text{ mmol m}^{-2} \text{ d}^{-1}$  exhibited higher tissue nitrogen concentrations than controls. However, subsequent experiments with N enrichment rates of  $1.5 \text{ mmol m}^{-2} \text{ d}^{-1}$  did not demonstrate elevated nitrogen tissue concentrations when compared to controls.

Blake, James A., ENSR, Woods Hole; Barbara Hecker, Woods Hole; and Eugene Gallagher, Univ. Massachusetts, Boston.

## DEVELOPMENT OF A THRESHOLD INDEX FOR MONITORING BENTHIC COMMUNITIES IN MASSACHUSETTS BAY

The new MWRA outfall in Massachusetts Bay is scheduled to begin discharges in late 1998. Soft-bottom benthic communities have been monitored annually since 1992. Due to the heterogeneous nature of the sediments, natural disturbance from storms, and trawling the development of an index or metric that would be indicative of change has been difficult to establish. Long-term trends in species diversity, species richness, and faunal composition are variable. Species diversity has been reexamined with regard to evenness which might be more informative than richness. Because rarefaction curves are log series, any departure from predictions might indicate less evenness and a possible disturbance. Results suggest that 30% of the stations are already disturbed from natural causes. Diversity was also examined from the standpoint of functional groups. The 50 most abundant taxa were classified according to 8 functional groups: suspension feeders, interface feeders, surface deposit feeders, reverse conveyor-belt feeders, subsurface deposit feeders, top-down conveyor-belt feeders, omnivores/scavengers, and predators. Ordination analysis using PCA-H resulted in high correlation with functional groups. When species were plotted against functional evenness, high correlations suggested that Warning levels and Red Flags could be developed as indicators of change. Warning levels would include: reduced species evenness, changes in community composition, and changes in functional group diversity. Red flags would include faunal shifts to nearshore assemblages, loss of species richness, and development of an "inner-harbor" evenness pattern.

Bohlen, W.F., O'Donnell, J., Howard-Strobel, M.M., and D. Cohen  
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TIMES SERIES OBSERVATIONS OF THE SUSPENDED MATERIAL FIELD WITHIN THE  
CONNECTICUT RIVER ESTUARY

The suspended material field in an estuarine reach is the resultant of interactions between a variety of sedimentological, hydrographic and meteorological factors. These interactions can be expected to display significant variability in space and time. In an effort to resolve these interactions within the Connecticut River Estuary, self-contained, bottom-mounted instrument arrays were deployed at three locations along the navigational channel first during January-February, 1993, a period of average streamflow and again in April-May, 1993 a period including above average streamflows. Each array was programmed to burst sample water temperature, conductivity, suspended material concentrations and current speed and direction four times each hour. Analysis of the resultant data set provides clear indication of a dynamic turbidity maximum generally sited near the limit of salinity intrusion. Suspended material concentrations throughout the estuary display a low frequency variability correlated with streamflows corrected for seasonal bias. The latter appears to be governed primarily by ground-cover characteristics and antecedent hydrograph. Tidal forcing and aperiodic meteorological events induce higher frequency variability. Spatial variations are typically small compared to concurrent temporal features.

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#### MODELING PHYTOPLANKTON PRODUCTION. II. APPLICATION OF AN EMPIRICAL MODEL TO SHALLOW WATER ECOSYSTEMS

We have found evidence that traditional modeling approaches often underestimate phytoplankton production, especially in shallow coastal lagoons. The empirical model developed by Cole and Cloern demonstrates a strong relationship between water column productivity ( $m^{-2}$ ) and the composite variable  $B \cdot Z_p \cdot I_0$  (biomass, photic depth, and incident surface irradiance). This association has further been shown to exist in several other studies of coastal water production. These empirical models have been derived for relatively deep estuarine systems (where photic depth < total depth), and have not been extended to shallow systems where light reaches the bottom. We propose a polynomial correction to the formulation based on the composite variable ( $B \cdot Z_p \cdot I_0$ ), can successfully predict phytoplankton production in a variety of shallow water systems (where total depth < photic depth). This is an important development in modeling shallow estuaries and coastal lagoons where relevant predictions (e.g. of oxygen dynamics) require predictions of rates as well as stocks to be accurate.

Brush, M.J.<sup>1</sup>, J.W. Brawley<sup>2</sup>, S.W. Nixon<sup>1</sup>, and J.N. Kremer<sup>2</sup>; <sup>1</sup>Graduate School of Oceanography, University of Rhode Island; <sup>2</sup>Department of Marine Sciences, University of Connecticut at Avery Point

#### MODELING PHYTOPLANKTON PRODUCTION. I. PROBLEMS WITH THE EPPLEY CURVE AND AN EMPIRICAL ALTERNATIVE

Ecosystem models tend to report predicted phytoplankton biomass, but many of these models underestimate primary production. Existing models are often based on the Eppley curve, which calculates maximum phytoplankton growth rate as a function of temperature. Despite the apparent wide applicability of the Eppley curve, some culture studies and field surveys have yielded growth rates in excess of those predicted by the curve. An alternate empirical formulation for predicting phytoplankton production from biomass, photic depth, and incident light has been shown to apply in a variety of estuarine systems. Comparison of this formulation to the Eppley curve has shown that the former predicts rates of production in excess of those predicted by the Eppley curve. The empirical formulation therefore presents an alternative to the more traditional Eppley curve in ecosystem models, and may yield more accurate estimates of production. Application of the empirical formulation to a shallow water ecosystem model is discussed in the accompanying paper.

Carlson, John K.. Southern Connecticut State University, Biology Department; Todd A. Randall, Biology Department, University of Mississippi; Matthew E. Mroczka, Cedar Island

Marine Research Laboratory

#### FEEDING HABITS OF WINTER FLOUNDER (*Pleuronectes americanus*) IN A HABITAT EXPOSED TO ANTHROPOGENIC DISTURBANCE

The feeding habits of the winter flounder (*Pleuronectes americanus*) were examined in a habitat subjected to chronic anthropogenic disturbance by organic and inorganic nutrient disposal and shipping activity. The macrobenthic community was numerically dominated by the types of polychaetes and amphipods found in a disturbed community. Little variability was found in the diets of 151 winter flounder (100-300 mm total length) in 4 size-classes. Combining all size-classes, winter flounder were found to feed on 18 different genera of macrobenthos. Amphipods and polychaetes dominated the diet. These groups provided from 12-25% of the diet by weight, 16-48% by number, and had index of relative importance values between 552 and 2,510. Major prey items were the amphipod, *Ampelisca abdita* and the polychaete, *Streblospio benedicti*. These diets were compared to those winter flounder captured in habitats where benthic assemblages were not exposed to human perturbation. Regardless of habitat, winter flounder fed on primarily the most abundant and active benthic species. This study supports the contention that winter flounder are in general, opportunistic feeders and usually feed on the most abundant and available prey source.

DeLeo, William. Chris Kincaid and Rob Pockalny, URI Graduate School of Oceanography EFFECTS OF SAKONNET RIVER CONSTRICTIONS ON MOUNT HOPE BAY FLUSHING

Circulation between the Mount Hope Bay (MHB) estuary and the Sakonnet River (SR) estuary is studied using a side mounted Acoustic Doppler Current Profiler (ADCP), tide gauges and a CTD. The MHB estuary is interesting because it has two distinct pathways to the ocean: one through the SR, and another through the East Passage (EP) of Narragansett Bay (NB). Previous ADCP data suggest that the two pathways disagree in flow direction at three distinct points in the observed tidal cycles, e.g., flow observed in through the SR pathway but out through the EP pathway. Since such a phenomena could have significant implications on the flushing of MHB, a study was designed to further investigate the nature and cause of the anomalous circulation patterns. The SR pathway has been identified as the area of greatest tidal energy dissipation in all of NB, likely due to its complicated geometry and breakwater-like constrictions. The hypothesis is that this geometry gives rise to the anomalous current patterns between inlets. This presentation will address the physical mechanisms responsible for exchange between the SR and MHB. The study results suggest that both tide and wind induced circulation is governed by the geometry.

#### Friedman, Ileana, Biology Dept., Brooklyn College CUNY DISTRIBUTION AND ABUNDANCE OF COPEPODS IN LOW MARSH POOLS IN JAMAICA BAY, NEW YORK - PRELIMINARY RESULTS

A variety of physical and biological factors lead to the formation of shallow low-marsh pools behind mussel dams in Jamaica Bay. Although pools destroy marsh vegetation, they support a variety of other organisms. Populations of copepods have been studied for 8 months at five sites (pools) plus an adjacent control site (intertidal Bay.) Pools vary in depth, size, distance from marsh edge, drainage, shading and *Ulva* biomass. Of 12 copepod species identified from pools, harpacticoids were dominant, including *Dactylopodopsis* spp., *Harpacticus* spp., *Mesochra lilljeborgi*, *Nitocra* spp., *Tachidius* spp.; the cyclopoid *Halicyclops magniceps* and calanoids *Eurytemora affinis* and *Oithona similis* were also numerically important. Nonharpacticoids dominated the control site. Continuing studies will focus on physical and chemical variability among pools in relation to copepod diversity and abundance.

Stephen Gephard, CTDEP/Fisheries Division, Old Lyme, CT

## **Constructing Small Scale Fishways in Connecticut to Support Anadromous Fish Restoration**

Most small and medium-sized streams that flow into tidewater in Connecticut historically supported runs of anadromous fish species, notably alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*). Past construction of low-head dams, culverts, and other structures blocked the species' migratory path and denied access to upstream spawning and nursery habitat. Fish runs were either extirpated or experienced dramatic declines in numbers. The Fisheries Division develops partnerships to build fishways at these sites as part of its anadromous fisheries management program. This paper will briefly review the life history of the targeted species, explain the designs of fishways commonly employed, and discuss the general approach used for planning, constructing, and operating small-scale fishways in Connecticut.

Grimsby, J. L., P. E. Fell. Connecticut College, New London, CT

## **PHRAGMITES CONTROL ON BRACKISH TIDELANDS OF THE LOWER CONNECTICUT RIVER ESTUARY: IMPACTS ON MACROINVERTEBRATES.**

The spread of *Phragmites australis*, or Common Reed Grass, has converted many areas of the brackish tidelands of the Connecticut River estuary from brackish short-grass meadows to monocultures of *Phragmites australis*. In order to control this spread and to restore the native marsh vegetation, a *Phragmites*-dominated marsh region on the north shore of the Lieutenant River was treated with the herbicide glyphosate at the end of the summer 1995. The following spring, the dead stands of *Phragmites* in this sprayed area were mowed and mulched. By the second growing season, a brackish short-grass meadow had been restored. On the opposite bank of the river, two *Phragmites* marsh regions were sprayed with herbicide and left unmowed, another was mowed/mulched without herbicide treatment, and another was left untreated for reference. Over the summer of 1997, these different marsh regions were assessed to determine the impacts of the various *Phragmites* control methods on invertebrate populations. The sprayed *Phragmites*, reference *Phragmites*, and restored meadow marsh regions supported populations of typical marsh invertebrates including *Orchestia grillus*, *Philoscia vittata*, *Succinea wilsoni*, and *Uca minax*. *Succinea wilsoni* was most abundant in the restored meadow marsh, while *Orchestia grillus* and *Philoscia vittata* were more abundant in the reference and sprayed *Phragmites* marsh regions. *Phragmites* marsh regions which had been mowed/mulched without herbicide treatment exhibited only small amounts of litter on the marsh surface and low densities of invertebrates. In litter manipulation experiments, invertebrate abundance was positively related to the amount of litter present on the marsh surface.

Hodum, Douglas, University of Maine, Department of Biological Sciences

## **THE POSSIBLE EFFECTS OF ENGINEERING STRUCTURES ON THE INVERTEBRATE COMMUNITY BIODIVERSITY OF THE MUDFLATS IN CASCO BAY, MAINE**

As sea level rises, shoreline erosion in New England and elsewhere is threatening valuable property. The attempted protection of that property through retaining structures may, in fact, be posing threats to the coastal environment. I am investigating the effects of engineered coastal bluffs on the invertebrate biodiversity of tidal mudflat communities along the central Maine coast. While tidal mudflats naturally accrete sediment from adjacent bluffs or undergo erosion, the engineered structures dramatically reduce the sediment supply and can lead to severe erosion. I am comparing species richness and evenness in mudflats adjacent to six natural and five armored coastal areas of varying size. Preliminary reviews reveal that species inventories for each of 230 samples show that species richness and evenness are similar among all sites and both tidal heights sampled. It appears that the common trend of having one or two dominant species with low abundances of other species occurs at these sites. Initial review of the sediment data collected at each site reveals no significant differences in grain size, total carbon and nitrogen content and enzyme hydrolyzable amino acids. It appears that many ubiquitous organisms, such as the polychaete *Streblospio benedicti*, are able to recolonize severely disturbed sites. While the analyses are incomplete, preliminary review of the raw data reveals that most engineered sites have communities similar to their natural counterparts.

Hughes, Jeff; Linda Deegan (Ecosystems Center, Marine Biological Laboratory), Jim Kremer and John Brawley (University of Connecticut) NITROGEN  
LOADING EFFECTS ON THE QUALITY OF JUVENILE FISH HABITAT

The major source of anthropogenic nitrogen in estuarine embayments on Cape Cod is nitrate in groundwater. Increased nitrogen loading causes excessive macroalgal and phytoplankton production, at the expense of eelgrass biomass and stem density. Degradation and loss of eelgrass habitat has been associated with declines in fish diversity and abundance in these systems. This year, we will extend an ecological model of the effects of excess nitrogen on estuarine primary producers and other water quality variables, to predict effects of nitrogen loading on eelgrass habitat and juvenile fish diversity and abundance. The generality of the extended model will be tested in estuaries along a gradient of nitrogen loading.

Kremer, James and the Thames River Study Group, Department of Marine Sciences, University of Connecticut and Project Oceanology, Groton, CT.  
DRAMATIC SUB-SURFACE CHLOROPHYLL MAX FORMATION IN THE UPPER SECTION OF THE THAMES RIVER.

Weekly water quality monitoring from June-September at six stations in the Thames River from Norwich Harbor to Long Island Sound documented the common appearance of a large, distinct maximum in photosynthetic pigments at about 1 m depth. Continuous vertical profiles were recorded with a cell equipped with an oxygen sensor and in vivo fluorometer. The shape and peak magnitude of the sub-surface pigment feature often changed dramatically within one to two km downriver of Norwich Harbor, the point where river water enters the estuary over dams. Large variations in the chlorophyll-fluorescence calibration factor were noted. While the origin of the pigment peak seems likely to be riverborne phytoplankton cells, the mechanism by which the fluorescence is concentrated within the strong halocline is uncertain. These algae represent a potential contribution of organic oxygen demand to the deepwater hypoxia of Norwich Harbor.

Latimer, James S., US Environmental Protection Agency; Scott, David B., Dalhousie University; Chmura, Gail L., McGill University  
PALEOECOLOGY IN THE COASTAL MARINE ENVIRONMENT: A TOOL FOR ENVIRONMENTAL ASSESSMENTS

The assessment of ecosystem degradation and recovery is an important part of coastal environmental science and management. Sediment cores are natural chronometers that can be thought of as passive samplers of coastal ecosystem condition. Biological, chemical, and geological indicators in cores, such as, for example, foraminifera, diatoms, dinoflagellate cysts, pigments, and xenobiotics, provide important information useful in detecting changes in aquatic systems. This approach has been used successfully in limnology to assess effects from, for example, eutrophication and acidity. In marine systems, difficulties arise due to the dynamic nature of the environment. To advance the development of paleoecological techniques as a tool for environmental assessments in coastal marine systems, research is ongoing to: (1) evaluate sediment cores as measure of how systems change in response to regulatory or socioeconomic factors; (2) determine the relationship between sediment core effects indicators and stressor indicators; and (3) determine if stressor and effects indicators can be associated with drivers of stress (e.g., watershed land use/land cover, wastewater and industrial loadings) and estuarine activities (e.g., marinas) in coastal systems. Examples of the use of this technique will be provided from ongoing research in New England and from studies in other areas in the US, Canada, and Europe.

Lewis, Ralph, Connecticut Department of Environmental Protection  
GEOLOGY OF THE LOWER CONNECTICUT RIVER VALLEY

The valley of the lower Connecticut River is cut in rocks that have been crushed, metamorphosed, torn apart, weathered, and glaciated over the 300 million years since these rocks were brought together in the continental collision that formed the Appalachian Mountains. The second of two known glaciers (Wisconsinan), moved southward into Connecticut around 26,000 years ago, and had advanced to its southern limit on Long Island by about 21,000 years ago. Systematic ice retreat followed, and by 17,500 years ago the ice front was depositing the Old Saybrook Moraine along the north shore of glacial Lake Connecticut (now Long Island Sound). As the ice melted northward from Saybrook Point, till blanketed the landscape, and runoff sought the easiest path across the bedrock to Lake Connecticut. This path was the ice-deepened bedrock valley, which eventually became choked with deltaic sand and gravel. The subsequent draining of glacial Lake Connecticut, isostatic rebound, and the draining of glacial Lake Hitchcock (to the north) resulted in significant stream incision of the deltas in the lower valley. The rising sea entered Long Island Sound about 15,000 years ago, and sedimentation replaced down-cutting in the valley. Post-glacial sedimentation has kept pace with sea-level rise, and the modern river system has developed on top of the glacial deposits in the bedrock valley.

MacBroom, James G., Milone & MacBroom, Inc., Cheshire, Connecticut

HYDRAULIC ANALYSIS OF TIDAL WETLANDS

The species of plants and animals in tidal creeks and marshes are influenced by the tide range, circulation, freshwater inflow, sediment transport, and salinity. Marsh management and restoration often requires hydrologic modifications to achieve the desired goals. The hydraulic analysis of tidal systems can be complex due to non-uniform and unsteady flow with analytical methods ranging from simple hand computations to one or two dimensional computer models. This paper describes the available computational methods and their assumptions, advantages, and disadvantages.

Mack, Joseph E., Alan M. Young, and Mark R. Fregeau, Biology Department, Salem State College  
COMPARISON BY SCANNING ELECTRON MICROSCOPY OF ATLANTIC AND GULF COAST  
POPULATIONS OF THE HERMIT CRAB, *PAGURUS LONGICARPUS*

*Pagurus longicarpus*, the longwrist hermit crab, has a known range along the western Atlantic coast from Minas Basin, Nova Scotia to Hutchinson Island, Florida. Florida represents a break in the distribution and the species is found separately in the Gulf of Mexico from Sanibel Island, Florida to south of Galveston, Texas. Morphological differences have been seen previously between the Atlantic and Gulf populations. Third maxillipeds and chelipeds of crabs collected from five locations (Nova Scotia, Massachusetts, North Carolina, west coast of Florida, and Texas) were examined using scanning electron microscopy. To date, differences in setation and dentition of the third maxilliped have been noted between Atlantic and Gulf populations, suggesting that these two populations may represent two different species.

Marshall, Angeline and Michael Dadswell, Department of Biology, Acadia University,  
Wolfville, Nova Scotia

#### THE ROLE OF EELGRASS (*ZOSTERA MARINA*) IN RELATION TO THE EPIBENTHIC MACROFAUNA IN MAHONE BAY, NOVA SCOTIA

The use of eelgrass (*Zostera marina*) beds by a number of marine species is well documented over a wide geographical range. The objectives of this study included determining which species of epibenthic macrofauna utilize the eelgrass in Mahone Bay as a permanent or temporary habitat or food source. Whether or not the function of the eelgrass can be defined as a nursery role was explored for each species. The organisms present in two eelgrass beds in Mahone Bay were sampled from June 1997 - October 1997. The macrofaunal abundance was correlated with water temperature, salinity, quality of sampling area (approximated by the density of eelgrass) and time of year. A total of 23 species were found in the eelgrass beds over the study period including decapods, mysids, isopods, amphipods, gastropods, bivalves, fish and asteroids. Because of the temporal abundance and age structure we decided that the eelgrass served as a nursery area for a number of these species, including *Cancer irroratus*, *Asterias vulgaris* and *Pagurus acadianus*, and as a permanent residence for most of the others. The total abundance of epibenthic macrofauna per sample was found to be affected by temperature, quality of sampling area and time of year.

Morss, Michael S., Bruce R. Woodin, Michael J. Moore, Alice M. Shumate, John J. Stegeman, Biology  
Department, Woods Hole Oceanographic Institution  
CELL PROLIFERATION IN ZOOPLANKTON AND LARVAL FISH.

Sufficient quantity and quality of prey is requisite for the growth of larval fishes and for the of copepods. Egg production in adult copepods is one measure of adequate nutrition. Assessing the growth and nutritional health of juvenile copepods and larval fishes is more difficult, and may be studied measuring somatic growth. Somatic growth, the result of cell proliferation, can be quantified by measuring DNA replication using the incorporation of bromodeoxyuridine (BrdU) into DNA or by determining the levels of proliferating cell nuclear antigen (PCNA), a DNA-polymerase helper protein with elevated levels in replicating cells. We quantified cell proliferation in feeding experiments with *Pseudodiaptomus coronatus* copepodites, larval winter flounder (*Pleuronectes americanus*), larval Atlantic cod (*Gadus morhua*), and other zooplankton species using immunohistochemistry and protein immunoblotting. In *Pseudodiaptomus coronatus*, BrdU incorporation was higher in animals reared at a high prey density compared to those fed a lower density of prey. Similarly, animals reared initially at low prey densities exhibited an increase in BrdU incorporation when fed at the higher prey density. Winter flounder and crab larvae reared in high prey concentrations also had increased PCNA expression over those reared at low concentrations. Larval cod fed different prey mixtures showed differences in their PCNA expression. Higher prey density allows an organism to expend less energy foraging and more on somatic growth and reproduction.

O'Donnell, James, W. Frank Bohlen, M. M. Howard-Strobel and D. Cohen, Department of Marine Sciences, The University of Connecticut  
OBSERVATIONS OF THE CIRCULATION IN THE ESTUARINE REACH OF THE CONNECTICUT RIVER

We report the results of three observation campaigns to quantify the mechanisms and magnitudes of the exchange of materials between the Connecticut River and Long Island Sound. During periods of high discharge and low discharge we deployed three moorings in the channel of the river. These instrument packages measured and recorded current and salinity for approximately a month. Observations were complemented by shipboard hydrographic surveys. We also report an interpretation of the observations of three acoustic Doppler current profilers moored by NOAA in the vicinity of the river mouth. We find that the river exhibits strong seasonal variation in the character of the circulation associated with changes in the discharge magnitude and the consequent influence on the hydrography. There is also strong variation in the subtidal flow associated with 3-5 day weather fluctuations. The observation near the mouth also display wind forced fluctuations but the subtidal circulation pattern is dominated by an anticyclonic eddy surrounding Long Sand Shoal. We present an interpretation of the dynamics that lead to these flow patterns.

Peck, Myron, David Bengtson, Robin Katersky, and Lisa Menard. An Energy Budget for the Inland Silverside, *Menidia beryllina*: Energetics vs. Life History in a Rhode Island Estuary.

Laboratory experiments were carried out to quantify the relationship between fish dry weight (dw) and food consumption (C), food absorption efficiency (A), respiration (routine oxygen consumption, R), and nitrogenous (ammonia, NH<sub>4</sub>-N) excretion (E) in young juvenile (5.0 mg dw), to mature adult (500 mg dw) inland silversides, *Menidia beryllina* (Cope). Experiments were conducted at a temperature (25±1 C) and salinity (30±1‰) which serve as a good proxy for summer conditions for the field population in a Rhode Island estuary. The scope for growth (SFG) = (C A) - (R + E) in joules (mg dw)<sup>-1</sup> (d)<sup>-1</sup>, gross growth efficiency (KI) = SFG / C, and metabolic costs (MC) = (R + E) / (C A), were calculated for fish over a size range of 5 to 500 mg dw. The allometric scaling factor (b) in the equation  $y = ax^{\exp(b)}$  relating C, R and E in joules (y) to fish dry weight (x) on a per fish basis (weight-specific basis) was equal to 0.511 (-0.447), 0.676 (-0.336), and 0.784 (-0.214), respectively. The absorption efficiency (mean ± SE) was equal to 89.4 ± 0.6 % of the food energy and was independent of body weight. For small fish (5 mg dw) the calculated energy available for growth (SFG) and the gross-growth efficiency (Hi) were equal to 4.26 J (mg fish)<sup>-1</sup> (d)<sup>-1</sup> and 50.4%, respectively, and markedly declined with increasing fish size. Ecological aspects of the energy budget for inland silversides are discussed including possible adaptive significance of patterns of metabolism and growth for fish in a Rhode Island estuarine habitat, and comparison with a sympatric congener, the Atlantic silverside, *Menidia menidia*.

Pregnall, Marshall, Biology Department, Vassar College, Poughkeepsie, NY  
SEASONAL NUTRIENT DYNAMICS IN THE CASPERKILL, A TRIBUTARY OF THE HUDSON RIVER ESTUARY

Physical and chemical characteristics, including inorganic nutrients, have been measured seasonally along the length of the Casperkill, a second-order stream in Dutchess County, New York, which is a tributary to the tidal freshwater portion of the Hudson River estuary. Increased summer temperatures depress dissolved oxygen and percent saturation, with downstream locations generally having higher oxygen levels than upstream ones. pH is neutral to slightly alkaline, with no evident seasonal pattern. pH and alkalinity gradually increase downstream. Phosphate is generally low, with no distinct seasonal or longitudinal patterns. Ammonium is highest at upstream locations that are dramatically impacted by human activities, while nitrate increases progressively downstream. A dammed pond, of unknown water-residence time, appears to be the location where the stream switches from being ammonium to nitrate dominated. The relative patterns of ammonium and nitrate persist throughout the year, despite the absence of measurable nitrification in stream water at downstream locations during any time of year, and at upstream locations during colder months. These observations imply that other sinks of ammonium and sources of nitrate, such as assimilation, stream sediment nitrification, groundwater input dynamics, precipitation and surface runoff, play important roles in the nitrogen dynamics of the Casperkill.

Phillippi, Aimee L. and Nancy J. O'Connor, Dept. of Biology, Univ. of Massachusetts Dartmouth  
EFFECTS OF SURFACE FLOCKING ON LARVAL AND ALGAL RECRUITMENT PATTERNS

We tested a new technique for minimizing biofouling of surfaces used in aquaculture. The effect of surface flocking (the attachment of small nylon fibers to smooth surfaces) on patterns of larval and algal recruitment was tested from June-October 1997. Flat PVC panels (12 cm x 12 cm) were attached to PVC frames, which were tied to the side of a floating platform in the Westport River, MA. Several flocked and unflocked panels were removed from the field monthly and replaced with clean panels. Other panels were kept in the field for 2-4 months, with observations and wet weights being recorded monthly. Dry and wet weights were recorded for each panel before and after field exposure. Species composition and percent cover were determined for each panel microscopically. Larger panels (24 cm x 12 cm) of both flocked and unflocked PVC and nylon netting were also deployed to determine differences in mass accumulation. Although results so far did not support the hypothesis that flocked panels have smaller gain in mass than unflocked panels, there were differences in species of algae and invertebrates that recruited to the two surfaces.

Randall, Todd A., Gulf Coast Research Laboratory; John K. Carlson, Department of Biology, University of Mississippi; Matthew E. Mroezka, Cedar Island Marine Research Laboratory  
DISTRIBUTION AND DENSITY OF SUBMERGED AQUATIC VEGETATION BEDS IN A CONNECTICUT HARBOR

Submerged aquatic vegetation (SAV), *Zostera marina* and *Ruppia marina*, was surveyed and mapped for an inventory of inner Clinton Harbor, Clinton, CT. Transects set at 30 meter intervals were established along the northern shoreline of the inner harbor, and SCUBA was utilized to count SAV short shoot densities. Surveys revealed that the majority of the inner harbor was dominated by low density grass beds. Nine areas of high density grass beds and ten areas of medium density grass beds were located. No SAV was found in the navigational channel or upon the mudflat along the northern shore of the inner harbor.

**Rozsa, Ron, CT Department of Environmental Protection - Office of Long Island Sound Programs.**  
BIOPHYSICAL SIGNATURE OF THE LOWER CONNECTICUT RIVER.

The lower Connecticut River is a tidal river and estuarine complex that was designated as a "Wetland of International Importance" in 1994. Described are the salient biophysical characteristics that underlie this designation such as regionally significant and exemplary tidal wetlands, outstanding submerged aquatic vegetation, and one of the largest concentrations of "rare" species in the entire watershed. The latter even includes manatee ("Chessie"). 5BNote: For more details, consult the Nomination Document which is to be posted on the web site of the Office of International Affairs of the USFWS in April(?) 1998:  
<http://www.fws.gov/7Er9dia/site.html>5D20

Ruber, Ernest and Jack A. Card, Biology Department, Northeastern University and Northeast Massachusetts Mosquito Control and Wetlands Management District.  
EXPERIMENTS ON THE CONTROL OF SALT MARSH *Aedes cantator* AND *AE. SOLLICITANS* WITH *BACILLUS SPHAERICUS* (VECTOLEX) AND AN ASSESSMENT OF POSSIBLE SIDE-EFFECTS TO COPEPODS.

Vectolex granules were applied to three Beverly, Mass. high salt marsh plots at 10 pounds/acre, three at 20 pounds/acre, with three more held as controls, Reduction of *Aedes cantator* larvae in application plots was excellent, with mortalities being significantly greater than in control plots. Larval control did not appear to persist into the next flooding dominated by *Aedes sollicitans*, although rain-flood patterns made the analysis less than ideal. A subsequent application in Newbury was less effective. Copepods were collected to determine possible side-effects. Copepod densities at both doses were significantly reduced although considerable numbers remained.

Saffert, Heather L., Drew A. Carey, and Peggy M. Murray, SAIC, Newport RI,  
Thomas J. Fredette, New England District, USACE  
MICROPALAEONTOLOGICAL TECHNIQUES FOR DEMONSTRATING CAPPING OF DREDGED SEDIMENTS

To demonstrate that dredged sediments can be placed and capped by another layer of dredged material, the New England District of US Army Corps of Engineers conducted a Capping Demonstration Project offshore of Portland, Maine. A low-cost method of tracking both underlying and capping dredged material, independent of potential associated contaminants, was evaluated to determine the effectiveness of capping operations at sites deeper than used before (>50 m). Benthic micro-organisms, known to occupy species-specific habitat ranges within estuaries, may serve as indicators of source material. Prior to dredging, sediments from the fresh water and marine regions of the Royal River estuary were characterized by distinct assemblages of foraminifera, thecamoebians, and other microbiota. The sediments dredged from the two regions were disposed in layers at a designated buoy at the Portland Disposal Site. Using micropaleontologic techniques, we analyzed core and grab samples from the site to identify the layers of dredged and ambient sediments and, therefore, verify the correct location of disposal and the extent of capping coverage. We applied multivariate statistics to determine the similarities between samples and to show the differences between sediment layers. The tracer technique provided a clear discrimination of a two-layered mound at the site in support of additional evidence from monitoring surveys. This technique can be applied to capping projects that require careful monitoring to ensure that no contaminated sediment is exposed to the benthos. Successful capping of sediments at deeper water sites may provide regional solutions for isolating contaminated dredged material from the marine ecosystem.

## **Abundance and distribution of adult shortnose sturgeon in the lower Connecticut River, 1988-1998.**

Tom Savoy (CT Department of Environmental Protection, Marine Fisheries Office, P.O. Box 719, Old Lyme, CT 06371;(860)434-6042; FAX (860)434-6150; tom.savoy@po.state.ct.us)

Information on the abundance and distribution of shortnose sturgeon in the Connecticut portion of the Connecticut River was needed to enhance management efforts to fully protect this species. The population size was estimated through mark recapture efforts. Data was pooled over all years to derive the best estimate. A total of 413 shortnose sturgeon were captured from 07/01/88 through 07/30/97 with 322 tagged and released and 73 recaptures. The number of 'adult' shortnose sturgeon (greater than 45 cm TL) below the Holyoke dam was estimated at 850 (95% CI 600-1000).

Attempts to collect immature shortnose (< 45 cm TL) have all been unsuccessful. Habitat use patterns and timing of movements were determined through netting and telemetry activities. Fifty one shortnose sturgeon have had ultrasonic transmitters implanted since 1988, with 39 providing useful long term (>60 days) information. Telemetry activities and sturgeon collections have identified several high use areas where shortnose sturgeon congregate in relatively high numbers and general seasonal movement patterns. Seasonal use of the estuary region is postulated as the single most important feeding area in the river. Utilization of saltwater remains unclear, although it is not likely that shortnose sturgeon have a mandatory oceanic phase of other anadromous species (American shad, Atlantic salmon, etc.).

Sung, Windsor and Maurice Hall\*, ENSR Consulting & Engineering; \*Massachusetts Water Resources Authority

### **TRACE METALS IN MWRA WASTEWATER**

The MWRA new offshore outfall is scheduled to be operational by the end of 1998. Some treatment milestones to date include the cessation of sludge discharge (end of 1991); a new primary treatment plant on Deer Island (1995) and new secondary treatment batteries (starting Fall 1997). In addition, sodium hydroxide and sodium carbonate are being added (since February 1997) on the potable water side for corrosion control. Trace metals in wastewater effluent have been monitored using ultra-clean techniques since June 1993 for Ag, Cd, Cr, Cu, Hg, Mo, Ni, Pb and Zn. We will present observations on the behavior of these trace metals in response to season and level of treatment. Trends and projected effluent quality discharged via the new outfall will be discussed.

Warren, R. S., P. E. Fell, K. Bowman, L. DeCosta, J. Grimsby, L. Israelian, G. C. Rilling, K. Williams, and J. Wilson. Connecticut College.

#### *PHRAGMITES* CONTROL ON BRACKISH TIDELANDS OF THE LOWER CONNECTICUT RIVER ESTUARY: IMPACTS ON VEGETATION, MACROINVERTEBRATES AND FISH.

Over the past ca. 30 years the vegetation within significant areas of the Connecticut River estuary brackish tidelands has changed significantly. The once diverse angiosperm community, characterized by *Spartina* spp., *Scirpus* spp., *Juncus* spp., *Caryx* spp., *Panic= virgatum*, *Typha angustifolia*, and *Agrostis stolonifrea* is now dominated by the invasive grass *Phragmites australis*. Experimental work to control *Phragmites* expansion, with the goal of restoring more typical brackish marsh vegetation was initiated in late August 1995 when ca. 18 ha of *Phragmites* dominated marsh on the north shore of the Lieutenant River was treated with the herbicide glyphosate. The area was cut the following spring with a mulching mower and has received no other treatment. In late summer of 1996 ca. 5 ha plots on the opposite bank of the Lieutenant were either mowed (1 plot), herbicided (2 plots), or left as an untreated control (1 plot). The impacts of these treatments on vegetation, primary production, macroinvertebrate populations, and fish use of tidal creeks was assessed over the summer of 1977. Half or more of the herbicide/mow treatment area supported diverse, *Agrostis/Spartina patens*-dominated brackish meadow vegetation. A small, ca 1- 2 ha portion, had low angiosperm cover; *Phragmites* survived as a near monoculture in the balance of the area. Total plant cover averaged <10% in the herbicide only plots. Vegetation in the mow only plot was essentially the same as in control areas, with total *Phragmites* cover of 75 - 90%. Invertebrate populations were similar in composition and densities in herbicide/mow, herbicide only and control plots; densities in the mow only treatment were reduced. These results are discussed in more detail in an accompanying poster (Grimsby and Fell). Fish use of tidal creeks in *Phragmites*, *Spartinaffypa*, and herbicide/mow areas suggest possible differences; this is an important area for future research.

Wiegner, Tracy N., Institute of Marine and Coastal Science, Rutgers University, New Brunswick, N.J. A COMPARISON BETWEEN PHOTOCHEMICAL AND MICROBIAL DEGRADATION OF DOM IN NON-POINT SOURCE RUNOFF

Up to 50% of the total nitrogen load received by estuaries is organic. Nitrogen can enter estuaries through a variety of point and non-point sources including urban and agriculture runoff, rainwater, and natural sources such as forest and salt marshes. This study was designed to compare photochemical and microbial degradation of dissolved organic matter (DOM) from non-point source runoff through outdoor and laboratory incubations. Runoff from agricultural areas as well as forest was examined. Photochemical degradation of DOM, measured as a decrease in DOC and DON (DOC and DON degradation) and an increase in NH<sub>4</sub> (DON degradation) concentration, was not detected in any of the light treatments for the agriculture and forest runoff. In comparison, significant microbial degradation of DOC and DON was detected within three days of the incubation for all three non-point sources. Lability of the DOM in the runoff was further supported by the rapid increase in bacterial production. Both the decrease in DOC and bacterial production support the conclusion that the DOM in the agricultural runoff is the most labile out of the non-point sources examined. Results to date suggest that photochemical processes are not as efficient at degrading DOM and releasing labile carbon and nitrogen compounds as the microbial community.