

NEW ENGLAND ESTUARINE RESEARCH SOCIETY

SPRING MEETING

May 4-6, 1978

**The Rusty Anchor
Boothbay, Maine**

ABSTRACTS

[NOTE: The abstracts for the papers presented at this meeting were never printed and made available to participants, and they have never been seen since that time by anyone other than myself. What you will find here is a compilation of the original submissions as mailed by presenters to the Program Chair of the meeting. – NEERS Historian, March 2006]

NEERS Meeting - Boothbay Harbor

May 4, 5, & 6, 1978

Determination of Trace Metals in Seawater
by Anodic Stripping Voltammetry (ASV)

Mary Lou Brann
Clarice M. Yentsch

Abstract

Low levels of cupric ion in seawater have been implicated to favorably condition the environment for a red tide bloom. Accordingly, the purpose of this work is to obtain a record of when and by how much the trace metal concentrations vary. Companion measurements of biological, physical, and other chemical parameters have been made on a seasonal basis at several stations in the Gulf of Maine. It is hoped then to relate these data with the blooms of the red tide organism, Gonyaulax excavata (tamarensis).

During the summer of 1977, daily samples were taken at one monitoring station at Monhegan Island and five cruises were taken to provide spacial coverage. All samples for ASV were taken in Nalgene bottles that had been acid washed with concentrated nitric acid. The samples were stored frozen. ASV methods were employed for analysis of cadmium, lead, and copper. The instrument used is a PAR model 174 A Polarographic Analyzer. So far, about 75% of the samples from Monhegan have been analyzed. The concentration ranges are: Cd 0.00 to 0.85 ppb; Pb 0.00 to 2.95 ppb; Cu 0.00 to 5.90 ppb. This method of analysis offers the advantages of being quite accurate and precise, and can measure the ionic (labile) as well as total concentrations of trace elements.

(STANDBY PAPER)

ABSTRACT TITLE: The delayed winter phytoplankton blooms of 1977
and 1978 in Eastern Long Island Sound.

AUTHORS: Linda E. Bireley, John P. Balser & Carl S. Fontneau

ABSTRACT:

Phytoplankton data collected over the last four years at the Millstone Power Station in Waterford, Connecticut indicated that the region was fairly typical of the adjoining temperate coastal waters of Eastern Long Island and Block Island Sounds both with respect to the qualitative and quantitative composition of the phytoplankton community and seasonal changes in the composition. In 1977 and 1978, however, the winter bloom was delayed from the "normal" late January to early February period to early March or later. Available data suggested that the delays might be related to light and/or temperature, or increased zooplankton abundance during late winter.

PROJECTION NEEDS:

Transparent Overhead Projector
Slide Projector

(ABSTRACT)

Heavy Metals in Connecticut Quahogs by

David W. Alley

U. S. Coast Guard Academy

The strontium, nickel, copper, zinc and cadmium content of quahogs Mercenaria mercenaria from relatively unpolluted waters off Noank (Ram Island) were compared to the heavy metal levels in these hard clams in samples from the more polluted Thames River and Milford Harbor waters. Not unexpectedly, the clams from the more polluted waters had higher metal contents. For example, the Thames River clams showed noticeable increases in zinc, strontium and, especially, copper. On the other hand, cadmium and nickel remained about the same.

(STANDBY PAPER)

Metabolism of Toxaphene by Estuarine Microorganisms

Fred Weber

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Abstract

Toxaphene is the most widely used chlorinated hydrocarbon insecticide in the United States. Although this compound may persist in soil for three years or more, it is reported to have a low persistence in estuarine areas. Microorganisms may play a role in the disappearance of toxaphene from salt marshes.

Two organisms of the genus Vibrio able to grow in the presence of toxaphene (100 mg/l) with glucose as the only other carbon source were isolated from Neponset River Estuary, Neponset, Mass. The data obtained after twelve days of incubation show a decrease in toxaphene content of approximately 30 in sterile controls and a decrease of about 60 in cultures. Further evidence for toxaphene metabolism is provided by growth of organisms with toxaphene as the sole carbon source.

Quantitation of toxaphene was performed by comparison of color densities of spots produced on thin layer chromatographic plates by extracts of cultures and sterile controls with spots produced by reference standards.

Work is in progress to determine the metabolic endproducts of toxaphene metabolism by Vibrio sp., their toxicity, and the rate at which toxaphene is broken down. Gas chromatographic analysis of the extracts is being performed to observe qualitative changes in the mixture after incubation and for more precise quantitation of toxaphene. A bioassay using Artemia sp. is being developed to determine changes in toxicity of toxaphene after incubation with organisms. A kinetic analysis of long term incubations may yield useful data for predicting the rate of biodegradation of this insecticide in the environment.

ABSTRACT

The Recovery of Aerococcus viridans (var.) homeri from Lobsters and Sediments

An experiment is described during which 75 lobsters impounded in surface water in Seabrook and Portsmouth Harbors were sampled for Aerococcus viridans (var.) homeri, the causative agent of a fatal lobster disease. Hemolymph was withdrawn from these lobsters every two weeks for four months during the winter. The organism was recovered from lobsters when water temperature was at or near 0°. The correlation between recovery of Aerococcus viridans (var.) homeri and environmental parameters is discussed. The lobster pathogen was isolated from sediments in both harbors by an enrichment procedure to be described.

[Jane Doherty, Normandeau Associates, Bedford, New Hampshire]

POLYCHAETA FROM A NORTHERN
PUERTO RICAN ESTUARY: PRELIMINARY SURVEY

Charlene D. Long
69 Windsor Street
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and

William Bhajan, Ph.D.
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As part of an ecological study of the Rio Espiritu Santo estuary on the north coast of Puerto Rico, 546 polychaetes were separated into 11 species in 9 families. Seventy-percent were Tharyx sp., 19% were CAPITELLIDAE species and 8% were Sigambra tentaculata (Treadwell, 1941). The remaining eight species each represented less than 1% of the total.

Seventeen stations were sampled along 2 3/4 miles, extending from the head of the estuary to the Atlantic Ocean. Most of the stations were clustered around river mouths, one of which, about mid-way to the ocean, receives sewage outfall.

The two major as well as two of the less common species had a pattern of delimited distribution by station. Tharyx sp. and Sigambra tentaculata were found from the outfall north to the Atlantic Ocean. Stenoninereis martini and CAPITELLIDAE species were found from the outfall south to the head of the estuary.

What is known about the biology of the species collected substantiates these distribution patterns. For instance, Sigambra tentaculata was collected at stations directly in river mouths only and has been so reported from several other North Atlantic localities. However, explanations for the division of the estuary into a northern and southern part, with an overlapping portion at the outfall, will have to come following further studies, such as of salinity values and of the amount of sewage entering the estuary at the outfall.

Prepared for the
Association of Island Marine Laboratories of the Caribbean
13th Regular Meeting
10-14 October 1977
Santa Marta, Colombia

Title: Analysis of Zooplankton Survival After Passage through a Power Plant

Authors: Deborah L. Taylor, Doreen S. Newhouse and Ronna LaPenn

Abstract: A vital staining technique was used to assess mortalities of organisms entrained at a steam electric generating plant. Selected zooplankton species data were subjected to multiway G-tests to determine whether or not survival differences by station and time (following entrainment) were significant. Use of the G-tests permitted a more quantitative interpretation of mortality data. Certain species appeared to experience greater mortalities than others; mortality of individual species varied with season.

ABSTRACT

THE DEVELOPMENT OF A FOULING COMMUNITY IN MID-COAST
MAINE.

The development of a fouling community on asbestos plates was observed over a period of 18 months. Several measures of community structure were used to determine the community dynamics over the observation period.

It was found that the secondary fouling community displayed a pattern of development which paralleled that of the primary fouling community. This parallel development was the result of a synchronous pattern of development rather than a causal relationship between the two communities. This is contrary to the experience of terrestrial ecologists. Both communities displayed changes in structure predicted by classical descriptions of succession.

Bryan Field
Ira c. Darling Center,
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NEERS MAY, 1978, MEETING - BOOTH'S BAY
HARBOR, MAINE

Ventilation and Oxygen Consumption in Nephtys incisa

Wayne R. Davis

U.S. Environmental Research Laboratory Narragansett, RI 02882

Nephtys incisa is a dominant deposit-feeding polychaete of the Northeast coastal soft bottom community. It burrows through, feeds on and irrigates the upper several centimeters of sediment at rates which are temperature dependent. This study documents ventilation activity and oxygen consumption in relation to worm size and temperature regimes spanning the seasonal range, 0, 6, 12, 18, and 24 C. Also, investigated was the influence of these ventilation activities on sediment oxygenation. A hot-bead thermistor flow meter was used to measure efferent irrigation rates and temporal patterns of worms maintained in one-inch thick sediment-filled aquaria similar to "ant farms." Metabolic rates were estimated in respirometry chambers using Clark-type polarographic probes. Rate of sediment oxidation, as indicated by sediment color change, was measured through planimetry of thin aquaria photographs.

During burrow ventilation, well oxygenated seawater is pumped through a complex open burrow system through parapodia ciliary activity in a close-fitting portion of the burrow. Respiratory exchange occurs across the body wall and segmentally paired dorsal recurved cirri. Whole organism oxygen consumption rate is seen to be influenced by dissolved oxygen levels, body weight temperature and activity. Indeed, oxygen consumption can be utilized as a general indicator of potential sediment reworking activity by Nephtys. Worm size and, thus, working depth also influence total sediment oxygen uptake. Ventilation activities of Nephtys incisa have been shown to enhance oxidation of organic containing sediment; as surface layers of benthic sediment are oxidized, a flux of materials between the sediment and water column would be expected.

ABSTRACT

THE PACKAGING OF OVA IN THE EGG CASES OF APLYSIA CALIFORNICA

Thomas R. Capo and Paul Kandel

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Laboratory observations on the spawn of Aplysia californica have revealed some significant and interesting results.

Egg masses from animals weighing as little as 19 grams to as much as 1300 grams were collected. The resulting data indicated a direct correlation between weight of parent and number of ova per capsule, diameter of cordon, and total weight of spawn. In addition, an inverse relationship was found between weight of parent and capsules per centimeter. In light of these findings we can account for much of the intra-species variation between egg masses.

The significance of these correlations as related to encapsulated ova and possible usefulness in weight-class determination will be discussed.

The Seasonal Importance of Micro-Zooplankton as Grazers of
Phytoplankton Biomass in Long Island Sound

by

Gerard Matthew Capriulo

An Abstract

In Long Island Sound micro-zooplankton were found to sometimes remove a significant portion of the chlorophyll *a* standing stock with an upper limit of 66 percent of the standing stock removed day⁻¹. As a community, the micro-zooplankton were found to exhibit the same order of magnitude filtering and feeding rates as those observed for the copepod community. Filtering rates varied from 1 to 85 $\mu\text{l animal}^{-1} \text{ hour}^{-1}$, seasonally. Feeding rates varied from 0.004 to 0.13 ng chlorophyll *a* removed animal⁻¹ hour⁻¹ and from 0.1 to 87 cells removed animal⁻¹ hour⁻¹, depending on season and type of cell being ingested. Micro-zooplankton abundance values ranged from 10⁻³ to 10⁻⁴ animals liter⁻¹. Numerically, over 90-percent of these animals were ciliates with tintinnid ciliates comprising approximately 80-percent of the total.

(Poster Display)

The 1978 Thames River (CT.) Spring Phytoplankton Bloom

by

Mark W. Cerasale
George T. Elliott
John M. Baker

U. S. Coast Guard Academy

This display will detail the spring phytoplankton bloom in terms of selected diatom counts, total displacement volumes, chlorophyll a, nutrient and associated environmental data.

Six feet of table and backwall should be adequate display room.

ABSTRACT

The Distribution of Benthic Macroinvertebrate Communities in Coastal
New Hampshire

Pat Clark, Weldon Bosworth, Ronna LaPenn

With the objective of providing baseline information on the composition and distribution of benthic macroinvertebrate communities, a comprehensive study is being conducted within the shallow subtidal areas off Hampton Beach, New Hampshire. The first years data have been subjected to both a normal and inverse Principle Component Analysis and these results combined by a constancy nodal analysis. The results of these analyses indicate: 1) The majority of the fauna including the numerically dominant are members of two ubiquitous faunal groups (one on hard substrate and one on soft substrate); 2) A small component of hard substrate fauna are distributed within three depth zones between 5-18 m below MLW, and, 3) One unique faunal group exists at 24 m below MLW determined by the depth of the station, the cobble substrate or a combination of both. It is concluded that faunal zonation does exist within the shallow subtidal off Hampton Beach but these zones appear to be of limited ecological importance since the numerically dominant species are ubiquitous and not restricted to any of the zones.

Lee E. Dunbar
Marine Sciences Inst.
Univ. of Conn. Avery Point

Title: Benthic community metabolism and nutrient flux across the sediment-water interface of an intertidal mudflat.

ABSTRACT

Benthic community metabolism and sediment-water nutrient exchange rates were measured in situ using a sealed core incubation technique. Simultaneous measurements of O_2 , CO_2 , and nutrient flux rates across the sediment-water interface indicate inorganic nitrogen species to be actively cycled by the sediment community, whereas PO_4 flux is independent of metabolic control on a diurnal time scale. Ammonia flux demonstrated significant diurnal periodicity based on an analysis of variance suggesting the microalgal community at the sediment surface plays a major role in controlling the release of NH_3 from the sediments. Multiple regression using O_2 and CO_2 flux rates was found to be a substantially stronger predictive tool than either O_2 or CO_2 flux alone for estimating nutrient exchange between sediment and water.

(STANDBY PAPER)

AN ECOLOGICAL CHARACTERIZATION OF MAINE'S COAST
NORTH AND EAST OF CAPE ELIZABETH

Energy Resources Co. Inc.

Stewart Fefer, Larry Thornton, Patricia Schettig, and Russ Brami

In 1975, the newly formed Office of Biological Services (OBS) of the Fish and Wildlife Service conceived the idea of characterizing the ecosystems of coastal areas for which new offshore energy initiatives had been proposed. The characterizations were to view physiographically distinct coastal areas as ecosystems, describing their important components and functional processes, and providing a mechanism for understanding the ecosystem through integration of components and interactive processes. Four coastal ecosystems were chosen for characterizations, the Pacific Northwest, the Chenier Plain on the Gulf Coast, the Sea Islands of Georgia, and the rocky coast of Maine from Cape Elizabeth to Passamoquoddy Bay at the Canadian border.

Energy Resources Company Inc. (ERCO) along with their subcontractor, Bigelow Laboratory for Ocean Sciences, have recently completed a test characterization of the coastal area in Maine dominated by the Sheepscot-Kennebec river estuaries. The study includes the marine (deepwater) environment to a depth of 300 feet and the terrestrial, estuarine and freshwater systems as far inland as Augusta.

The test characterization embodies the original tenets established by the OBS in 1975. The approach of the characterization is holistic; it treats the entire coastal area as a single, functioning, interacting ecosystem. The habitats within the Maine coastal ecosystem are defined as terrestrial, wetland, and deepwater. The hierarchical structure of the habitats is based upon the new classification of deepwater and wetland habitats of the United States by the OBS National Wetlands Inventory and classification of terrestrial habitats by the Maine State Planning Office.

The deepwater and wetland habitats may contain a number of different systems including marine, estuarine, lacustrine (lakes), palustrine (freshwater wetlands, bogs), and riverine. Forest, non-forest, agriculture, and developed land comprise the systems associated with the terrestrial habitat.

The test characterization discusses in detail the systems, subsystems, and classes that comprise the Maine coastal ecosystem. The discussion focuses on four primary concepts: energy flow, biogeochemical cycling, abiotic factors, and biotic factors. The discussion of each concept is based on data from the area combined with current knowledge of the general functioning of each concept within the various systems. Graphic displays are used to illustrate energy flows, food webs, and biogeochemical cycles within each system. In addition, the characterization emphasizes a Groups of Interest approach to describe interrelationships between commercially and ecologically important groups of species and their environments. Each Groups of Interest section discusses the use of habitats, reproductive strategies as controlled by existing environmental factors, and the importance of man and management for a particular group of species.

The Maine Coast test characterization consists of eight descriptive volumes with a series of sixteen interactive over-lay maps depicting distributions of systems, flora and fauna, location and magnitude of physical factors (such as tides), and other important information. In addition, it contains a computerized Data Source Appendix of 2000 references key-worded for easy access. The Test Characterization is a first step toward a comprehensive characterization of the Maine coastal ecosystem.

GROWTH RESPONSE OF THE BIVALVE TAPES JAPONICA FED
THALASSIOSIRA PSEUDONANA (3H) GROWN IN CONTINUOUS
CULTURE WITH VARYING CARBON AND NITROGEN LEVELS

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ABSTRACT

In the absence of defined, formulated diets for bivalve molluscs, nutritional information for juvenile specimens of Tapes japonica has been delineated by manipulating the biochemical composition of a diatom of known food value. This was accomplished in continuous culture with various light intensities, dilution rates (i.e. growth rates) and nitrogen loadings. Carbon/nitrogen (C/N) ratios in the range of 3.2-12.0 were affected for Thalassiosira pseudonana (3H). Four diets, comprised of various levels of PC and PN, were fed to experimental populations of T. japonica for a period of four weeks as growth, biodeposition, ammonia excretion and glycogen levels were monitored.

The greatest increase in shell length, dry meat weight and carbohydrate content occurred at an algal C/N ratio of 8.4 although protein content and assimilation of organic material were at a minimum. Ammonia excretion increased in direct proportion to particulate nitrogen in the diets from 36.7 to 54.7 mg $\text{NH}_4^+\text{-N/g}$ live weight/day.

This data suggests that the delivery ratio of individual components may affect the nutritional value of algal cells with respect to growth and physiology of shellfish.

(STANDBY PAPER)

TITLE: Trends in size, sex, movements and catchability of lobsters (Homarus americanus) and rock crabs (Cancer irroratus) in Piscataqua River Estuary, N.H.

AUTHORS: Robert Hasevlat and Neil Savage

ABSTRACT

Ten wire traps, tended since 1971, in the lower Piscataqua River near Newington, NH, from April to November, have provided much evidence of stability, but also some evidence of change in certain attributes of rock crab and lobster populations. Among the changes observed were a slight decline in the average size of both male and female rock crabs (female crabs were shown to be significantly smaller than males), and a substantial increase in the catchability of American lobsters. This on going study is part of an ecological monitoring program to assess the impact of thermal discharge from a steam electric generating station which has been operating since 1975. However, difficulties arise in attributing the afore mentioned changes to operation of the power plant. Nevertheless, the currently held hypothesis is that at least the recent increase in lobster catchability is peculiar to the Piscataqua River estuary.

Abstract Title: Geochemical Effects of Episodic Sedimentation Events in the Upper Chesapeake Bay.

Lead-210 dating of undisturbed sediment cores from the upper Chesapeake Bay has revealed that half of all the sediment deposited in this area since 1900 has been carried by two great floods which occurred in 1936 and 1972. The radiometric chronologies have confirmed previous sedimentation rate estimates made by sediment budget models. Most of the material that makes up the flood deposits has been resuspended from the bottom of the Susquehanna River by the flood waters. The river borne flux of lead-210 and other soil-derived metals is reduced after floods due to soil erosion in the drainage basin. The geological importance of large flood events to the estuary is underestimated by statistically calculated recurrence intervals of large river flow.

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MARTHA'S VINEYARD SHELLFISH GROUP

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ABSTRACT

A PROGRAM FOR THE DEVELOPMENT OF THE SHELLFISHERIES OF FIVE TOWNS ON MARTHA'S VINEYARD. Richard C. Karney, Martha's Vineyard Shellfish Group.

The Martha's Vineyard Shellfish Group, a consortium of the Shellfish Departments of five Island towns, has initiated a program to improve and expand the traditional shellfisheries in the waters of the member towns under a grant from the Economic Development Administration. Attempts are being made to develop practical shellfish culture methods for local application. Although addressing itself primarily to the biological aspects of the fishery, our program of community resource development has expanded into social, educational and marketing areas as the need has arisen.

We concentrated our investigations on the quahog as it offers the greatest potential for a stable year-round fishery. Major efforts were directed toward the development of raft and bottom culture methods for hatchery-raised seed quahogs. Nursery rafts proved far superior to bottom culture by effectively excluding non-swimming predatory green crabs. Of the various raft designs tested, economical sand-filled wooden trays suspended from floats gave the best growth and survival. In an experiment comparing growth of rafted seed at 18 locations, we observed slightly better growth in the upper reaches of the ponds away from the inlets.

The bay scallop supports an important Island fishery providing employment in the off-season when tourist dollars are scarce. Seed scallops have been tagged and released in an attempt to gather growth and survival data. We are trans-planting breeding stock to backwater areas in hopes of stabilizing harvests in ponds where strong circulation patterns frequently flush larvae from the ponds before they set. The Group is working in conjunction with the NMFS lab in Oxford, MD to determine the causative agent of abscesses found in Island scallop muscles.

The oyster is an underutilized species on the Vineyard. We are working with local fishermen and Island restaurants to develop this potential fishery. We experimented with oyster spat collectors in several ponds testing shellbags and shell-strings and determined good and poor spat collection sites.

In addition the Group provides an informational and educational service to the community. We answer requests for information from fishermen and provide shellfish expertise to local decision-making bodies.

Abstract

Preliminary observations on the abundance, distribution, and growth of post-larval sea scallops, *Placopecten magellanicus* on Georges Bank.

by

Richard M. Lee and Peter F. Larsen

Post-larval sea scallops, *Placopecten magellanicus*, were collected from Georges Bank with a modified Smith-McIntyre grab at 16 of 41 stations in February 1977 and 12 of 42 stations in May 1977. These records represent the first time that such young individuals have been found in their natural benthic environment.

Post-larval scallop abundance did not correlate with depth, median sediment grain size, bottom water temperature, or salinity. The length of the scallops collected during February ranged from 0.2 mm to 2.8 mm with a mode at 0.8 mm and a mean length of 1.0 mm. In May, the length ranged from 0.5 mm to 2.5 mm with a mode at 0.9 mm and a mean length of 1.3 mm. In other words, from the time of settlement, the post-larval sea scallops were found to grow to 1.0 mm in two months and to 1.3 mm in five months.

The possible implications of these findings to the fishery, which is the most valuable on Georges Bank, will be discussed as will the possibility of scallop stock assessment based on larval recruitment.

New England Estuarine Research Society

May 4, 5, & 6, 1978

Boothbay Harbor, Maine

Occurrence of Red Tide Resting Cysts

in the Gulf of Maine

Carrie M. Lewis
Clarice M. Yentsch

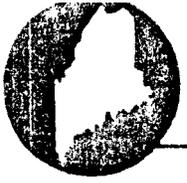
Abstract

Toxicity in shellfish resulting from the toxic red tide dinoflagellate Gonyaulax excavata (tamarensis) has been monitored along the Maine Coast since 1958. These data show an extremely spotty occurrence of the toxin.

There are two forms of the causative organism. One is motile; the other is an over-wintering resting cyst found in the sediment. It has recently been established that the cysts not only re-seed motile populations in the spring, but are themselves toxic and, in some cases, probably cause shellfish toxicity directly.

An extensive cyst mapping project has been initiated. The objective is to determine the distribution of cysts in sediments along the Gulf of Maine coast and to determine whether or not there is a correlation of winter cyst distribution and summer shellfish toxin distribution.

Although results to date are preliminary, approximately fifty stations have been sampled. Cysts were present at all primary shellfish monitoring stations sampled. Dense concentrations of cysts were found near the 100 M contour off Monhegan Island. This cyst bed has been sampled on a monthly basis to determine changes in the cysts themselves as well as to monitor when excystment occurs.



23 March 1978

Abstract for Paper to be presented at NEERS Meeting, Spring 1978

Abnormalities in the Shell of the Maine-Grown European Oyster (Ostrea edulis)

High percentages of the European flat oyster, Ostrea edulis, exhibit unusual greenish deposits on the inner valve surfaces. These deposits are conchyolinous in nature and differ from the blister typical of parasitic responses, in that they are firmly incorporated into the underlying shell layer. A frequency study carried on at six commercial oyster grow-out sites along the coast of Maine, revealed variations in incidence attributed to site and age class. The percent occurrence at colder, northern sites was considerably less (14-34%) than at more southern, estuarine sites (16-80%), while older age classes exhibited significantly higher frequencies (26-78%). Significant differences were also evident in percent coverage and areas of concentration on the shell surface. 86.5% of the affected oysters (470) had less than 20% of their valve surfaces covered, and the deposits were strongly concentrated on and around the adductor muscle scar and less significantly, in the hinge area.

The condition of the animals is unaffected and the mantle adjacent to the deposits appears to be unaltered. Histologic examinations have not yet revealed any possible etiological agents, although typical inflammatory responses are present in the tissues. SEM studies are presently underway to further describe the abnormal deposits, as well as continued histological and decalcified shell smear preparations. Speculations are made on the etiology of the abnormal deposits, both from a pathological and an environmental viewpoint.

Maureen D. Logue
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A Preliminary Budget for Copper in the Great Bay Estuary, N.H.

Wm. Berry Lyons
Henri E. Gaudette
Department of Earth Sciences
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During the past two years, we have been involved in the study of the fate of various trace metals in the sediments of Great Bay estuary, N.H. We have compiled all the available data concerning the distribution of copper in the sediments and waters of Great Bay and the Gulf of Maine and have constructed a preliminary copper budget for the estuarine system. The model is an input-output box for the sources, sinks and routes of reactive copper. The budget requires that the major sources of Cu, land runoff and sewage Treatment plant effluent, are equal to the major sinks of Cu, the sediments and outflow of estuarine water to the continental shelf. The riverine input of Cu is still a major unknown and appears to be extremely sensitive to the rate of Cu sedimentation in the estuary. Within the framework of three different sedimentation rates: (1) 0.02 cm/yr, determined through particulate matter budgets, (2) 0.1 cm/yr, determined by Holocene sea level rise and (3) 0.3 cm/yr, determined by chemical means, the riverine input of Cu may vary by an order of magnitude.

Bigelow Laboratory For Ocean Sciences

A Division of
Northeastern Research Foundation, Inc.

New England Estuarine Research Society
1978 Spring Meeting - May 4 - 6, 1978

February 16,

Abstract

Title: Inorganic Nitrogen Uptake by Phytoplankton near
Squirrel Island

The results of an 18-month study of nitrate and ammonium uptake will be discussed. Surface samples were collected on a weekly to monthly schedule and the stable isotope, ^{15}N , was used as a label to determine nitrate and ammonium uptake rates. Incubations were done at ambient temperature with natural and artificial light. Seasonal patterns of uptake will be shown, and the effect of light in determining these patterns will be discussed in detail.

Projection needs: 2 x 2 slide projector
and/or overhead transparency projector

[Jane J. MacIsaac, Bigelow Lab]

Marine Research Lab, University of Connecticut, Noank 06340.

Last year at NEERS, estimates of the benthic organic carbon supply in Quiambog Cove were presented. Studies of the metabolism of the microbenthos are continuing, and this year some pore water chemistry data will be presented and related to organic carbon deposition.

Soil moisture samplers used in agricultural sciences were installed at 16 stations in early March, 1976. During April and July pore water was obtained from the 30 and 60 cm horizons and analyzed for pH, Eh, Cl^- , SO_4^{-2} , NH_3 , CH_2O , dissolved organic carbon (DOC), and titration alkalinity (TA).

Relative to concentrations in overlying estuarine water, NH_3 , DOC, and TA ranged between 150 - 1500X, 10 - 40X, and 1.5 - 10X, respectively, during April. Sulfate was never totally depleted, and CH_2O ranged between 5 and 28 μM . During July, pore water DOC was much lower than April, while TA increased significantly (up to 84 meq l^{-1}) and SO_4^{-2} was relatively unchanged.

Among the April pore water data, regressions of NH_3 , DOC, and TA on SO_4^{-2} depletion were positive and significant ($P < 0.01$, $n=15$). However, July pore water obtained from the same samplers had very different characteristics. The slope of DOC vs. SO_4^{-2} depletion was reduced 7 fold, while TA and SO_4^{-2} depletion were statistically unrelated.

Common diagenetic models are not appropriate for these data, since several mechanisms appear to regulate specific pore water equilibria. Supplies of organic carbon at the benthos and in the pore water are sufficient to deplete SO_4^{-2} , but this does not occur. Several mechanisms which might explain these observations are not appropriate for all pore water characteristics. (Any suggestions??)

(STANDBY PAPER)

NEERS ABSTRACT

Overwintering Intertidal Aggregates of the Mud Snail,
Nassarius obsoletus.

The mud snail, Nassarius obsoletus has been observed overwintering in aggregates upon ice-covered tidal flats. The aggregates are comprised almost entirely of adults thickly clustered together with the uppermost individuals often imbedded in ice and overlying others buried in mud. The aggregates are widely dispersed, range 0.3 - 6.0 m² in area, and include about 1600 - 32,000 snails with both sexes represented.

Further details are being gathered on the depths of aggregates within the mud, winter survival, sex ratios, the physical environment and the behavior of aggregating snails in the Spring. Also under consideration are the relations between aggregates, schooling behavior and seasonal reproduction of N. obsoletus.

Presented by Michael Mazurkiewicz and Michael Day
(University of Maine at Portland-Gorham)

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COLLEGE OF ARTS AND SCIENCES
BIOLOGY DEPARTMENT

Macrobenthic invertebrates of the Housatonic River estuary

by Brian Meehan

A continuing survey of the macrobenthic invertebrates of the Housatonic River estuary in Connecticut has been conducted under the auspices of the University of Bridgeport Marine Biology Program since July, 1977. Samples of the benthic organisms, temperature, and salinity have been taken monthly at five stations spaced irregularly along the upper 16 kilometers of this estuary. The number of species along the observed segment of the estuary is low, with no more than one dominate form at any one station except at station five, where both Chiridotea almyra and Scolecopelides virides occur together in consistently large numbers. Chiridotea almyra, found at four of the five stations, appears to be the only widely distributed species. The highest bottom temperature was reached in August, the average for all stations being 26.5°C. The lowest, in December, averaged 4.3°C. Preliminary salinity data show that the Housatonic River estuary is a typical salt-wedge estuary, wherein salinity increases with depth, and **only** slight vertical mixing occurs. As expected, salinities on a horizontal axis also change drastically: average bottom salinity at station one is 0.25 ‰; 4.3 ‰ at station five.

The Application of a New Sea Floor Mapping System for Delineating
Benthic Environments

Charles A. Menzie and Hugh F. Mulligan
EG&G, Environmental Consultants, Waltham, Massachusetts 02154

A new Sea Floor Mapping System which utilizes side scan sonar is described. The system produces, in real time, an accurate geomorphological map of the sea floor. Different benthic environments can be delineated and their areas accurately measured. In addition, the system records back-scattering data on magnetic tape in digitized form. Thus data are always available for further display and computer analyses. A sonograph of the sea floor off Marblehead, Massachusetts, is presented to illustrate the system's applications. Further applications of the system to estuarine and coastal ecology are discussed.

Authors: Mickelson, Claudia
Yentsch, Clarice
Lewis, Carrie
Mague, Francis
Hurst, John

Organization: Bigelow Laboratory for Ocean Sciences
West Boothbay Harbor, Maine

Toxicity of *Gonyaulax excavata* Cysts

Benthic resting cysts of the New England red tide dino-flagellate *Gonyaulax excavata* have been found in the flocculant sediment layer from samples from several stations off the coast of Maine. Sediment samples were collected at one station on a monthly basis beginning in October, 1977. The resting cysts were separated from the bulk of the sediment and bioassayed for toxicity by the mouse test. The toxicity of the cysts collected in October was several orders of magnitude greater than the toxicity of motile *G. excavata* cells. The cysts isolated from subsequent monthly samples showed a consistent loss of toxicity, reaching the levels of toxin found in the motile cells by February. Changes in the intracellular cyst morphology were observed between October through February.

The ability to form motile cells from the cyst stage (the process of excystment) was also monitored for the October through February period. Motile cells were not observed to form from cysts until the February collection, suggesting that *G. excavata* has a mandatory dormancy period of about 4 to 5 months.

In summary, *G. excavata* cysts are highly toxic; the toxicity and cysts morphology changes with time; and the ability to excyst apparently correlates with low toxin levels.

TITLE: A Bioenergetic Approach to Modelling the
Decomposition Processes

AUTHOR: James Reed, Ecosystems Center, MBL, Woods Hole, MA

ABSTRACT: A simulation model is presently under development to elucidate the factors controlling decomposition in a salt marsh. Work, thusfar, has concentrated on microbial processes, i.e. the oxidation of reduced compounds and production of various end products (CO₂, H₂S, microbes, etc.). The model determines the proportions of, end products from 1) the Gibbs free energy of formation of each of the reactants, 2) maintenance requirements and 3) population turn-over time.

The rate at which these products are formed is regulated by the concentration of available substrates and the speed at which electrons can be passed down the cytochrome chain to the terminal electron acceptor. From efforts to validate the model it became evident that the physio-chemical processes, such as leaching, diffusion, particle size, etc., are as important to the decomposition process as is the biological control, through predation, natural death, substrate specificity, etc., of the microbes themselves.

(STANDBY PAPER)

Siderophore-production by marine bacteria

by

L.J. Spencer, M. O'Connell, J. Tugel, and G.E. Jones
Jackson Estuarine Laboratory
University of New Hampshire
Durham, New Hampshire

Among nutrients governing marine productivity, colloidal hydroxides of iron may be limiting to the growth of marine phytoplankton. Specific chelating agents, siderophores, capable of solubilizing and transporting such unavailable iron to phytoplankton cells may have distinct beneficial effects on marine productivity. Siderophores are a class of metabolites (hydroxamic acids) which are produced by some microorganisms under iron-deficient conditions. Arthrobacter flavescens is a culture which is stimulated by siderophores. This investigation was undertaken to examine the siderophore-producing ability of bacteria isolated from different marine environments.

Heterotrophic marine bacteria have been isolated on a peptone-yeast extract medium from estuarine sediments, from pelagic water in the Great Bay-Little Bay estuarine system, from coastal water located six miles southeast of Portsmouth Harbor, New Hampshire as well as oceanic stations proceeding west from the arc of the Lesser Antilles to the approximate center of the Caribbean Ocean. Random isolation of the marine bacteria from agar plates was bioassayed for identification of distinctly positive Arthrobacter flavescens stimulating bacteria. The low-nutrient sea water samples from the Caribbean Ocean contained 46.6% bacteria-producing a positive bioassay. Random bacteria from the pelagic waters of the New Hampshire coast and estuary gave 24.2% positive bioassay whereas only 4.7% of the bacteria isolated from estuarine sediments gave a positive bioassay. It was concluded that the percentage of Arthrobacter flavescens stimulating bacteria isolated from these various environments may be inversely proportional to the concentration of biologically available iron. The availability of iron as a micronutrient in these environments may be related to the percentage of bacteria capable of producing-siderophores.

Trace Metal Studies in Marine Phytoplankton Cultures by
Differential Pulse Polarography

by

L.J. Spencer, M. Salvaggio, and G.E. Jones
Jackson Estuarine Laboratory
University of New Hampshire
Durham, New Hampshire

Differential pulse polarography is a valuable and versatile technique for monitoring enriched trace metal distribution as a function of growth for Dunaliella tertiolecta. The quantities of metal assimilated and loosely bound by the cells may be determined as well as the changes in complexing capacity of the media.

The effects of growth of D. tertiolecta on the distribution of enriched metal was examined in 5×10^{-6} M cadmium, and 5×10^{-6} M copper enriched F/2 media. All of the observable "free" Cu, and 74% of the observable Cd was complexed prior to inoculation. A 96% decrease in observable Cd occurred over a 161 h period with a rate of 4.6×10^{-9} M/liter/h; a 55% decrease in an observable Cu complex occurred over a 187 h period with a rate of 8.3×10^{-10} M/ liter/h during log growth, and 3.7×10^{-9} M/liter/h during stationary growth. Concentrations of loosely bound metal were less than 3.7×10^{-9} M/liter for Cd grown cells and less than 8.3×10^{-9} M/liter for Cu grown cells.

(STANDBY PAPER)

Comparative Studies of Nutrient and Carbon Fluxes and
Resultant Interactions Between Marsh Mudflat
and Channel areas in a New England Estuary

Barbara L. Welsh

Nutrient and carbon fluxes along an open marsh front, its bordering mudflat and an adjacent channel were compared to determine what the relative contributions of each subunit were to the overall system. In addition I was curious as to whether these individual areas differed regarding net flux, which could account for some of the contradictions in existing literature, and whether results obtained from open-system measurements agreed with those reported for enclosed or semienclosed systems. The study took place in Branford Harbor, Ct. Intensive sampling between June and October covered both summer production and transition to the fall regeneration period, with supplementary measurements at other times of the year.

Basic patterns of flux differed between the three areas. The mudflat, although situated between marsh and channel, did not conform to either one or to any proportional mixture of the two. Expected flux for the mudflat, as purely a zone of mixing and passage, was compared with its observed flux. The pattern of the difference between the two, termed "net mudflat effect", was far more consistent seasonally than either the expected or the observed component, and was ecologically far more defensible. The channel consistently exported materials. Marsh behavior was mixed according to nutrient and season. The mudflat, however, consistently imported everything except nitrite in quantities sufficient to replace marsh deficits. Removal mechanisms which have been identified and partially quantified are; 1) the mud surface itself and 2) the Ulva, which increases surface contact with the passing water by 6-20 times and adds a third dimension to the epibenthic component. Return mechanisms are 1) local processing by mud snails, Ilyanassa obsoletus, 2) decomposition by

benthic microheterotrophs, and 3) return of nutrients toward shore by tidal resuspension.

A comparison of the fluxes from the three areas, as well as their comparison with existing literature from other areas, reveals the complimentary functioning of the marsh and mudflat subunits and the conservatory nature of their interaction. These data support my ongoing investigations into the following paradigm for nearshore systems: Tidal movement performs a bidirectional transport function, indispensable to the system, but its operation is basically under physical control. It is the fixed components of the system, both benthic epibenthic, which contain the genetic capacity as well as the local community fidelity to respond on an evolutionary scale to the tidal phenomenon, and thus achieve the fine-tuning and control necessary for self-perpetuation at the ecosystem level. In an applied sense, the key to why one particular coastal system will survive perturbation such as eutrophication while another may not probably lies at two distinct levels: 1) the ecological subunits involved and their functional contribution to the system as a whole, and 2) the collective genetic plasticity of the biological elements within each subunit.

Visual aid requirements:
35 mm slides

overhead for transparencies.

Marine Sciences Institute
University of Connecticut
Avery Point
Groton, Connecticut 06340

Hydrography of the Gulf of Maine, Northeast
Channel and Adjacent Slope Water

by

W. R. Wright and R. J. Schlitz
National Marine Fisheries Service
Northeast Fisheries Center
Woods Hole, Massachusetts 02543

ABSTRACT

A volumetric T/S census of the deep basins of the Gulf of Maine, based on a cruise in May, 1976, shows the bulk of the water deeper than 100 m lying along a line from the Slope Water values of 8.5°C, 35.0 ‰, to values of 5.2°C, 32.8 ‰, overlain by seasonally warmed fresher water. There is a tighter T/S relationship in the basins farthest from Northeast Channel than in Georges Basin—just inside the channel, and there are differences in the mean T/S curves for individual basins. This indicates that the more remote basins are changed infrequently by massive intrusions of Slope Water. One such intrusion apparently occurred in early 1976. Current meter and temperature records suggest that the deep inflow through Northeast Channel in winter consists of Slope Water at intervals of 4-10 days. In the shallower water, above the shelf break at 100 m, salinity and temperature distributions show mostly westward flow of Scotian shelf water, some crossing the channel onto Georges Bank and some branching northward into the Gulf of Maine. The pattern is interrupted by occasional intrusions of Slope Water which are apparently not related to the deep inflow.

INVERTEBRATE DISTRIBUTION PATTERNS ON SUBTIDAL ROCKS

Two theories have been proposed to explain the distribution patterns along environmental gradients: the community-type theory and the continuum theory. This study was designed to test the applicability of these theories to distribution patterns of organisms on subtidal rocks. Fifty samples, ranging in depths from zero to ten feet below low tide line, were enumerated for seaweed, prosobranch mollusks, and crustaceans associated with algal fronds. The data was analyzed by direct ordination, cluster analysis, principal components analysis, and correspondence analysis. The conclusions depended to a certain extent upon the numerical method. The results support a third possibility; a "fluid" model in which there is some local structure without distinct boundaries.

Luana Read
Marine Sciences Institute
University of Connecticut
Groton, Connecticut

Bernie McAlice
Ira C. Darling Center
University of Maine
Walpole, Maine 01573

March 19, 1978

Dear Dr. McAlice,

I am sure this abstract will reach you after March 23, but I hope you will consider it for the N.E.E.R.S. meeting in early May.

ABSTRACT: Distribution of In-vivo Chlorophyll Fluorescence in the New York Bight, August 1977 and April 1978.

Basically a show-and-tell, the presentation will be based on vertical fluorescence profiles taken on multiple time-series stations and transects. The profiles were taken with a submersible fluorometer. This device, the FTD, also contains a temperature and depth transducer in a water-tight housing. The study area ranges from Shinnecock Inlet on Long Island to Barnegat Inlet on the New Jersey shore, and offshore to the continental shelf break. These profiles (from August) illustrate some well known principles and phenomena of biological oceanography, such as: photoinhibition in surface waters, vertical movement of chlorophyll layers by internal waves and differences between inshore and offshore communities (relative magnitude of the chlorophyll content). I will attempt to include some data from 4-16 April, 1978 in hopes of describing seasonal changes in distribution.

PERSONAL:

I am a second year graduate student here at the Marine Sciences Research Center, State University of New York at Stony Brook. This data forms the basis of my masters' research. Under the direction of Dr. Wayne Esaias I hope to complete my degree in August, 1978.

Hoping you can find room in the seminar schedule I remain,

Sincerely yours,

Joseph J. Tokos

(STANDBY PAPER)

Title: Comparative Study of the Population Processes (Movements, Growth, and Mortality) of the Larvae of the Rock Gunnel, Pholis gunnellus Linnaeus, a Fish.

by

David Townsend
Oceanography Department
Ira C. Darling Center
University of Maine
Walpole, Maine

Abstract: The objective of the proposed research is to estimate rates of movement, growth, and mortality of the larval rock gunnel, Pholis gunnellus Linnaeus, in an estuary (Sheepscot River) and an embayment (Sullivan Harbor) which have differing current systems. Preliminary results have included analysis of the larval rock gunnel from collections maintained by the State of Maine Department of Marine Resources from larval fish surveys conducted along the Maine coast during the month of April 1974-1977. Length-frequency data is presented and differences between eastern and western coastal sectors discussed. Preliminary studies on the efficacy of trapping recently metamorphosed gunnels and the abundance and distribution of adults are also discussed.

Title: The seasonal variation in the flesh weight and total lipid content of the bay scallop, Argopecten irradians (Lamarck)

Lawrence L. Drolet

Abstract: Specimens of scallops were collected at more or less monthly intervals between July, 1975 to June, 1976. Size, whole wet weight, soft tissue whole wet and dry weights, and shell weight were determined. Soft tissues were divided into four components 1.) gonad and foot, 2.) digestive gland, 3.) large and small adductor muscle and 4.) remaining tissues which included mantle and gill. Wet and dry weights were determined on each component. Total lipid analyses were performed on the four components throughout the study.

Projection needs: slide projector

This work is a segment of a thesis presently being written for the M. S. degree.

[Note: This handwritten submission did not scan legibly and was therefore transcribed by the NEERS Historian, March, 2006]

Lawrence L Drolet
Marine Science Institute
Northeastern University
Boston, Mass.

ABSTRACT

The voracity of the predatory marine snail, Polinices duplicatus

D. Craig Edwards and Judith D. Huebner
Department of Zoology, University of Massachusetts, Amherst

The year-round feeding of Polinices of different sizes was monitored directly in field cages. Provided with excess Mya arenaria of differing sizes, Polinices of each size ate similar numbers of prey (mean = 95.5 Mya per snail per year); however, since larger predators selected larger prey, they ingested more (mg or cal) than smaller ones. With a specified food supply and experienced predators, temperature and predator weight together accounted for most of the variability in ingestion. Feeding peaked at 0.6 Mya per snail per day in summer, but ceased for 4 months in winter. Only about 80% of each Mya (mg or cal) was actually ingested. On a year-round basis, ingestion rates of Polinices were only about 1% of their own weight per day or up to 36 kcal per m². The voracity of Polinices is not exceptional; it is comparable to that of other invertebrate predators.

Needs: 2 x 2 slide projector and blackboard.

ABSTRACT

The Reproduction Cycle of mahogany quahog, Arctica Islandica

Pat Clark

The reproductive cycle of Arctica islandica from beds off Hampton Beach, New Hampshire is being observed. Gonadal blocks were dissected from monthly samples of 25 individuals and identified for reproductive state. Males indicated slow but active spermatogenesis during winter and early spring, increased rate during April through June, spawning during the summer months with the greatest percentage in late summer-early fall and a slight resting period during November. Females indicated a gradual increase in the rate of oogenesis throughout the winter and early spring, spawning during the summer with the greatest percentage during late summer early fall and a resting period during November. The reproductive cycle observed agrees with the observations of other studies reported in the literature. It appears that the critical minimum temperature of 13°C reported previously does not apply to this population. The majority of the individuals began spawning when the bottom temperatures were above 10°C.

Steven Edwards
Uni. of Conn.
Marine Sciences Institute
GROTON, CONNECTICUT 06340

13 March, 1978

Bernie McAlice
Ira C. Darling Center
Uni. of Maine
Walpole, Maine

Dear Dr. McAlice

Included is my abstract for the Spring NEERS meeting.

Seasonal Aspects of Nutrient Recycling by the Mud Snail
Nassarius obsoletus

Due to its density on mud flats and its consumptive habits the mud snail, Nassarius obsoletus (Say) is suspected of playing a significant role in nutrient recycling in estuaries and, therefore, affect productivity at different trophic levels. To examine this predication population size and nutrient recycling studies have been conducted with the mud snail on a seasonal basis. Metabolic products that have been measured include several dissolved organic and dissolved inorganic excretory products and fecal production. Uptake experiments by autotrophic members of the Branford Harbor mud flat community have also been initiated.

Slide projection and perhaps an overhead projector will be needed.

Sincerely,

Steven Edwards

Title: Baseline Studies of the Physical Oceanography of
Cobscook Bay, Maine by Paul A. Schroeder, New England College.

ABSTRACT

Cobscook Bay, Maine, is a highly dynamic environment and, with its potential for tidal power and marine aquaculture, it is becoming an increasingly important area from an environmental and economical standpoint. Current and circulation studies were conducted utilizing tracing dyes and aerial photography and found high degrees of diffusion, shear effects and homogeneous stratification. Extreme tidal currents were recorded in excess of 2 m/s. Shoreline configuration shows the effects of these extreme tidal currents by the beveling and winnowing of various points and coves. Analysis of suspended particulate matter in the water column revealed a range of 1-6 mg/l, with little spatial variation between the inner and outer bay. Temperature, salinity, and particulate matter concentrations indicate there is a constant renewal of oceanic waters from the Bay of Fundy throughout the entire bay complex. Volumetric determinations were made in the area of Falls Island and it was found the volumetric exchange which occurs through this area is on the order of $1.0 \times 10^8 \text{ m}^3$. This work may prove helpful in assisting in the assessment of man's potential to manage this specific region of the coastal zone.

Special Needs: 35 mm Carousel Slide
Projector Flashlight Pointer

Thank you for considering this paper for presentation.

ON THE GUT, SOUTH BRISTOL, MAINE 04568
(207) 644-8180

TITLE: GROWTH RATES IN SUBTIDAL POPULATIONS OF MYTILUS EDULIS
ALONG THE MAINE COAST AND THEIR RELATIONSHIP TO ENERGY
FLOWS, TOTAL BIOMASS (DENSITY) AND SHELL MORPHOLOGY

ABSTRACT: A 1977 survey of the commercially important mussel beds along the Maine coast included detailed surveys of twenty (20) major beds. Among the several biological parameters that were examined was growth rate. Ages of 6 cm and 7 cm mussels were determined using disturbance rings as indicators of annual growth. Although this method has been employed by several workers (Lubinsky, 1958; Andrews, 1972; Seed, 1973; Thiesen, 1973), growth rates observed for the Gulf of Maine were not in agreement with those found by Mossop (1921), Field (1922), and Richards (1935). The apparent discrepancy in growth rates may be in the methods that have been employed to date (i.e. counting of disturbance rings). In an effort to establish precise ages and growth rates for a number of major mussel beds along the Maine coast, internal shell structure will be examined using the method refined by Lutz in 1976. Acetate peels of polished, etched longitudinal shell sections reveal annual cycles in Mytilus, which are reflected in growth increment sequences in the innermost shell layer.

In addition to the age determinations, an apparent relationship between growth rate and shell morphology will be investigated. The effect of population density and gross energy flows on growth rates will also be examined.

James Chalfant, Alton West, and Thomas Archambault
Maritec,
South Bristol, Maine

"A Corporation founded by Maine People for Maine People"

(ABSTRACT)

Heavy Metals in Connecticut Quahogs by

David W. Alley

U. S. Coast Guard Academy

The strontium, nickel, copper, zinc and cadmium content of quahogs Mercenaria mercenaria from relatively unpolluted waters off Noank (Ram Island) were compared to the heavy metal levels in these hard clams in samples from the more polluted Thames River and Milford Harbor waters. Not unexpectedly, the clams from the more polluted waters had higher metal contents. For example, the Thames River clams showed noticeable increases in zinc, strontium and, especially, copper. On the other hand, cadmium and nickel remained about the same.

ABSTRACT TITLE: The delayed winter phytoplankton blooms of
1977 and 1978 in Eastern Long Island Sound.

AUTHORS: Linda E. Bireley, John P. Balser & Carl S. Fontneau
Northeast Utilities

ABSTRACT:

Phytoplankton data collected over the last four years at the Millstone Power Station in Waterford, Connecticut indicated that the region was fairly typical of the adjoining temperate coastal waters of Eastern Long Island and Block Island Sounds both with respect to the qualitative and quantitative composition of the phytoplankton community and seasonal changes in the composition. In 1977 and 1978, however, the winter bloom was delayed from the "normal" late January to early February period to early March or later. Available data suggested that the delays might be related to light and/or temperature, or increased zooplankton abundance during late winter.

PROJECTION NEEDS:

Transparent Overhead Projector
Slide Projector