

New England Estuarine Research Society

ABSTRACTS OF PAPERS

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(Contributed Paper Session at ERF Meeting)

MT. POCONO, PENNSYLVANIA

A DISSOLVED SILICA BUDGET FOR NARRAGANSETT BAY. S.W. Nixon, C.A. Oviatt, B. Nowicki, Graduate School of Oceanography, University of Rhode Island, P. Kremer, Allan Hancock Foundation, University of Southern California, and S. Hale, Graduate School of Oceanography, University of Rhode Island.

The dynamics of dissolved silica in Narragansett Bay, R.I., were studied over an annual cycle based on measurements of silica in bay water as well as in river inputs and sewage. The rate of dissolution of silica from bottom sediments was also measured in situ so that inputs could be compared with recycling.

OVERWINTERING EFFECTS OF THE MANTIS SHRIMP, *Squilla empusa*, IN NARRAGANSETT BAY. William J. McCluskey, Jr., Graduate School of Oceanography, University of Rhode Island.

SCUBA observations in Narragansett Bay on silty-clay sediments indicate an average density of the burrowing stomatopod *Squilla empusa* of 1.1 animals/m². They construct U-shaped burrows approximately one meter long and one-half meter deep. In winter, however, they excavate one entrance, deep burrows, to an average depth of 2.4 m. Burrows to a depth of 4.4 m have been recorded. Effects on biostratigraphy and sedimentary geochemistry are being investigated. Analyses of burrow water metal contents indicate higher concentrations of Cu, Ni, Mn, and Zn than in water at the sediment surface. Seasonal information indicates that *Squilla* may act as a biomechanical pump, recirculating metal-rich water from its burrow into the overlying water column.

The causal mechanism behind this deep burrowing behavior was shown to be the animal's low tolerance to winter temperatures. Temperature profiles in the burrow and in the adjacent sediments show the animal utilizing heat stored within the sediment to maintain itself at a temperature above 5°C.

Other aspects of the effects of *Squilla empusa* on the estuarine environment will be discussed. Further work on a formal experiment to closely define its lower incipient lethal point and an experiment investigating oxygen consumption at low temperatures may be completed by the conference date.

ENVIRONMENTAL CONTROL OF SHELL AND BODY GROWTH PARAMETERS IN *Littorina littorea* (L.) ALONG AN ESTUARINE GRADIENT. Talbot Murray, Graduate School of Oceanography, University of Rhode Island.

Studies currently underway at the Graduate School of Oceanography on shell growth in *Littorina littorea* have demonstrated that parasitism can significantly affect the morphology of this snail. Parasite associated changes in adult snails are such that multivariate linear models can be generated to discriminate between parasitized and non-parasitized snails without dissection, using six variables, with an associated error of only 12%. In this report, additional growth associated parameters are included and comparisons between parasitized and non-parasitized snails are made along an estuarine gradient. The use of multivariate statistical models also allows the isolation of specific variables responding to change along the gradient. This technique also provides for a ranking of their importance in explaining the observed variation. These models therefore provide a powerful tool for understanding the relative importance of biological vs. environmental control of growth.

FACTORS AFFECTING SURVIVAL AND GROWTH OF YOUNG SOFT SHELL CLAMS, *Mya arenaria*, IN NORTHERN NEW ENGLAND. Neil B. Savage, Normandeau Associates, Inc.

Six years of monitoring soft shell clam populations in one New Hampshire estuary, and almost two years of surveys in five adjacent estuaries, have provided considerable historical data on population dynamics. Shell-length-frequency diagrams have been utilized to determine year classes, and to estimate age-specific growth and survival rates. Major influences on cohort survival appear to be predation pressure from a natural predator, *Carcinus maenas*, and from man. Closing and opening clam flats to diggers has had considerable impact, although evidence suggests this impact is secondary to that of the green crab population fluctuations. Densities of the 1976 spat set were approximately seven times those previously observed in "good" years and afforded an excellent opportunity to test hypotheses about the various factors affecting repopulation. For the 1976 year class, flats in Plum Island Sound, Massachusetts, yielded substantially larger shell sizes than the five more northerly flats, inviting speculation as to the reason for the apparently more favorable growth conditions.

METHODS OF GROWING HATCHERY RAISED QUAHAUGS IN THE NATURAL ENVIRONMENT. Sandra Libby, Shellfish-Harbormaster Department, Orleans, Massachusetts.

Pilot projects begun in 1975 in several Cape Cod communities were greatly expanded in 1976, so that 8 out of 15 towns were participants in the program of using varying methods to grow hatchery-raised quahaug seed to legal size in the natural environment.

In Orleans, 10,000 seed were purchased in 1975, and approximately 400,000 seed were purchased in 1976. In 1975, seed were planted in the intertidal zone in 10 locations and covered with netting for protection from predation. In 1976, both bottom culture and rafting were used in

approximately 30 additional locations. In 1977, . t h e same amount of seed was used in both bottom and raft culture methods. The bottom cultures were in sub-tidal, rather than intertidal, locations, to try to reduce winter kill from heavy ice conditions.

Generally, in Orleans the raft method gave the best growth, but also produced additional problems. The quahaugs grew to 18-32 mm from May through September, while: the bottom cultured quahaugs reached 10-24 mm in the same period. Each method began with seed of 6-10 mm. Survival ranged from 85-99% during the summer but dropped to 40-50% after an extremely harsh winter.

In November, 1976, a workshop sponsored by the Massachusetts Division of Marine Fisheries examined the methods and results obtained by communities involved in the project. Other communities experienced results similar to those of Orleans. Chatham found that quahaugs grew equally well with both methods, and therefore decided to use only bottom culture for the 1977 season. We expect that similar results will be obtained and that some problems will be solved during the 1977 season.

A NATIVE-AMERICAN ATTEMPT TO IMPROVE AND STABILIZE THE PRODUCTION OF THE BAY SCALLOP, *Aequipecten irradians*, IN MENEMSHA POND, MARTHA'S VINEYARD, MASSACHUSETTS. Dennis Walsh, Wampanoag Fisheries Project.

The Wampanoag Tribal Council of Gay Head, Martha's Vineyard, Massachusetts, with grants from the Economic Development Administration is trying to improve and stabilize the bay scallop population of Menemsha Pond, a traditional fishing ground for the Wampanoags.

Water samples are taken weekly during the critical spawning season from 15 June to 15 August to determine nutrient and chlorophyll content and temperature and salinity distribution at 18 to 24 stations. Tide gauge studies, drift bottle experiments, and aerial photography of dye patches are used to determine wind and current patterns in Menemsha Pond. The flushing rate is of such magnitude that the majority of shellfish larvae liberated in the pond are removed by wind and tidal currents before set can occur. Water quality is excellent for growth and survival of set scallops.

To bypass the swimming stage, 110,000 scallop seed (depth 1-3 cm) were obtained, and placed in rectangular pens at various locations in the pond. The growth rate was monitored and compared to native seed. Survival and growth were excellent. There was an average 130% increase in length and 1,836% increase in weight of these scallops from July through October, 1976. During the second year of this program, a mini-hatchery has been erected at the pond. Five members of the Wampanoag community have received training in basic hatchery techniques. To date, the algal subsystem of the hatchery has been developed to the point where 5 gallons of log phase Thal-3H can grow out to 50 gallons of culture in two days. The hard clam, *Mercenaria mercenaria*, has been used in larval rearing experiments because of its hardiness and relative ease in rearing. Hard clam larvae have been successfully reared to setting stage by the Wampanoags. Attempts will be made to condition, spawn, and rear bay scallops during the fall, when the animals have recovered from the summer spawning.

EFFECTS OF PENTACHLOROPHENOL (PCP) ON THE ESTABLISHMENT OF MEIOBENTHIC COMMUNITIES IN A FLOW-THROUGH EXPERIMENTAL SYSTEM. Frank R. Cantelmo and K. Ranga Rao, University of West Florida.

Aquaria containing clean sand received a continuous supply of seawater from Santa Rosa Sound, Florida, mixed with known quantities of PCP for 9 weeks (May 10 - July 12, 1976) for the first experiment and 12 weeks (December 22, 1976 - March 28, 1977) for the second experiment. Concentrations of PCP were 7, 76 and 622 $\mu\text{g}/\text{l}$ in the first experiment, and 1.8, 15.8 and 161 $\mu\text{g}/\text{l}$ in the second. At the end of each experiment the meiofauna established in the control and experimental aquaria were examined. Nematodes were the dominant group and averaged 83% of all the meiofauna encountered. Concentrations of 1.8, 7 and 15.8 μg PCP/l did not affect the biomass and density of nematodes. An intermediate concentration of PCP (76 $\mu\text{g}/\text{l}$) caused an increase ($P < 0.01$) in biomass and density of nematodes compared to control aquaria. Higher concentrations of PCP (161 and 622 $\mu\text{g}/\text{l}$) caused a decrease ($P < 0.01$) in biomass and density of nematodes compared to control aquaria. Although species diversity indices of control aquaria did not differ significantly from those of PCP-exposed aquaria, marked changes in nematode species composition and shifts in nematode feeding types were noticed in the aquaria exposed to 161 and 622 μg PCP/l. Nematodes classified as epistrate feeders were most abundant in the control aquaria and those exposed to 1.8, 7, 15.8 and 76 μg PCP/l. Deposit feeders were relatively abundant among the nematodes in aquaria exposed to 161 and 622 μg PCP/l. The alterations in nematodes observed in this investigation appeared to be due to the variations in macrobenthic fauna and food (algae) supply caused by the biocidal effects of PCP and also due to the toxic effects of PCP on meiofauna. (This investigation was supported by Grant R-804541-01 from the U. S. Environmental Protection Agency.)

TRACE METAL AND ORGANIC CONTAMINANTS IN COASTAL AND ESTUARINE SEDIMENTS OF MASSACHUSETTS. Gilbert L. Chase, Environmental Analysis Branch, New England Division, Army Corps of Engineers.

In 1971 the New England Division, Corps of Engineers, initiated a sediment sampling and testing program to satisfy requirements stipulated by the U.S. Environmental Protection Agency's criteria for determining the acceptability of dredge material for ocean disposal. Bulk chemical analysis is presented for Hg, Pb, Zn, As, Cu, Cd, Ni, V, percent volatile solids, chemical oxygen demand, total Kjeldahl nitrogen, hexane solubles, and total carbon from 29 Federal navigation projects. The results show that average Cd values from all projects tested exceed the current 0.6 ppm EPA criterion. The concentrations, however, are of the same order of magnitude as those reported for regional shelf and bay sediments. The average Hg content in sediments from four harbor areas and the Mystic River, Boston, also exceeded EPA limits. Anomalously high Hg levels (e.g., 12-13 ppm) characterize Falmouth Inner Harbor, Cape Cod. The mean surface value of 7.46 ppm for this project is greater than in any other New England locality where maintenance dredging is performed.

Consistently higher parameter values are correlated with those areas having industrial and sewage discharges, marine services and restricted boundary conditions or low energy environments. Maximum concentrations of constituents are correlated with silt-clay sediments. Surface and subsurface value comparisons show a decrease with core depths exceeding 30 cm. Elutriate "shake" tests were performed for some projects as an additional technique for determining the acceptability of materials for specific ocean site disposal.

EFFECTS OF SPOIL DISPOSAL ON THE BENTHIC INVERTEBRATES OF THE NEW LONDON (CT.) DUMPING GROUND. Robert Reid and Ann Frame, National Marine Fisheries Service, Northeast Fisheries Center, Sandy Hook Laboratory.

Sediments and benthic macrofauna of the Thames River and New London disposal area were sampled on an approximately quarterly basis between June 1974 and September 1976 to monitor spread of spoils and impacts on benthic communities.

Macrofauna community structure analysis showed large changes in faunal densities over space and time, with slightly smaller fluctuations in numbers of species, species diversity, and equitability. Outside of the immediate spoil pile, changes appeared random relative to distance from the disposal buoy. We concluded that spoiling impacts were small in comparison to natural fluctuations for the study area as a whole.

Observed changes in species composition may indicate slightly greater spoiling impacts than were revealed by analyses of density, diversity, and species richness. Changes in species composition could thus be the more sensitive measure of spoiling effects.

Significant recolonization of the spoil pile was seen within 13 months of the onset of disposal. Numbers of species and individuals continued to increase through the September 1976 sampling. Dominant recolonizing forms were those which had characterized predisposal communities in the area. Fairly complete and rapid recovery from the first increment of spoiling was predicted.

SUBLETHAL EFFECTS OF NO. 2 FUEL OIL ON LARVAL ENERGETICS OF *Crepidula fornicata* (Gastropoda), *Cancer irroratus* (Crustacea) and *Libinia emarginata* (Crustacea). D. Michael Johns and Jan Pechenik, U.S. Environmental Protection Agency, Environmental Research Laboratory, Narragansett, Rhode Island.

Larvae were reared in sublethal concentrations of No. 2 fuel oil (water accommodated fraction- WAF) in the laboratory. Sublethal levels for the larvae of each species were determined from survival rates at the following oil (WAF) concentrations: control, 10 ppb, 0.1 ppm, 1.0 ppm. In all three species, 1.0 ppm was found to be lethal within several days. All lower levels were sublethal. *Crepidula fornicata* larvae were reared at 20°C and approximately 30 ‰ salinity in control and 0.1 ppm oil concentrations. Both *Cancer irroratus* and *Libinia emarginata* larvae were reared at optimal levels of temperature and salinity (15°C, 30 ‰ for *C. irroratus*; 20°C, 30 ‰ for *L. emarginata*) in control and 0.1 ppm oil concentrations. The media in all containers were replaced daily and fresh food added at each water change.

Measurements were made of larval growth, respiration, and ingestion rates. *C. fornicata* larvae showed reduced growth rates coupled with depressed feeding rates at 0.1 ppm. Feeding rates and growth rates were depressed while rates of energy expenditure were elevated in both *C. irroratus* and *L. emarginata* larvae reared at 0.1 ppm.

ENERGY FLOW ON A NORTHERN MASSACHUSETTS SALT MARSH. Ernest Ruber, Gregory Gillis, Robert Murray, and Paul Montagna, Northeastern University.

The energy flow of a salt marsh partly adjacent to and partly in the Parker River National Wildlife Refuge is assessed. Data include live and dead standing crop measurements of 8 quadrats of 0.25 m² each for tall *Spartina alterniflora*, dwarf *Spartina alterniflora*, *Spartina patens*, and *Distichlis spicata*, and 4 quadrats of *Juncus gerardi* on 4 dates of the growing season. Standing crop data on *Salicornia*, *Typha* and *Scirpus* are also included. These are integrated with transect cover data for this marsh.

Calculations of algal mat and phytoplankton production in salt marsh pools as measured by bell-jar and D.O. bottle light-dark techniques are included.

Measurements of particulate detritus exchange rates from high (*S. patens*-*D. spicata*) and low (*S. alterniflora*) marsh under various tidal ranges and during 8 months of the year have been made. Disappearance of *S. alterniflora* from 5 mm mesh litterbags started at two different times of the year, and followed from two weeks to two years, is integrated into the scheme.

We believe this to be the most complete study of its kind from this far north on the east coast.