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ECOLOGY OF SURF CLAM BEDS

by

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Introduction

The objectives of the subtask are to evaluate the effects of various contaminants on the ecology of surf clam beds, and compare these effects with predators and unsuitable grain sizes as limiting factors of surf clams and other invertebrates. Specific studies involve examining the effects of: 1) contaminants in the water on development, survival and growth of invertebrate eggs and larvae; 2) grain sizes of, and specific contaminants, including those in sewage sludge, in bottom sediments on setting densities of surf clam spat and juveniles of other invertebrates; 3) contaminants in sediments on burrowing rates of adult surf clams; and also measuring: 4) contaminant accumulations in adult surf clams; 5) pollutant loss from sediments if discharges of the pollutants were reduced; 6) how much dilution of sewage sludge by spreading it over a far wider area would reduce its adverse effects; and 7) the variation in densities of invertebrates by season.

Methods

A variety of methods are used to collect the needed data. For bioassays of water quality in the New York Bight, water is collected in a bottle at several sites and tested at the Milford Laboratory. For studying invertebrate settlement in different sediments, trays which are 22-1/2 cm wide, 45 cm long and 7.5 cm deep are used; experimental sediments are put in the trays which are then placed on the seafloor for various periods. For determining pollutant loss from sediments, sludge from the sewage dump site has been held in a wooden box, 135 x 45 x 15 cm, at Ambrose Tower in 80 feet of water for one year. For studying variations in the density of invertebrates by season, invertebrates were collected at eight stations in the New York Bight apex on a

monthly basis for two years; five grabs were taken at each station and a 0.5 mesh was used when washing the samples.

A study of settlement densities and mortalities of surf clams by predation was conducted by making SCUBA observations of the beds and by periodic sampling with a hydraulic suction device. The divers were able to observe behavior of crabs, which are the principal clam predators, and also the clams.

Results

Bioassays of New York Bight apex water were done in 1982. The percentages of oyster eggs which were abnormal after 48 hours varied among locations. The percentages of eggs which developed were much lower at the sewage dumpsite and in the Hudson-Raritan plume, especially in Ambrose Channel than in less contaminated areas. Oyster eggs were used because they are a convenient bioassay organism, and it is believed that results with them would be representative of many invertebrate eggs found in the apex.

In a 1982 study of invertebrate settlement, far fewer invertebrates were found in trays containing sewage sludge than in uncontaminated sand. Thus, it was shown that sewage sludge is highly toxic to most settling invertebrates. A 0.5 mm mesh was used to wash the sediments, however, and thus it was not determined whether the missing invertebrates had avoided the contaminated sediments or died upon setting and passed uncounted through the screen.

In the 1983 study, a 0.25 mesh screen was used which retained setting larvae and more results were obtained. They can be summarized as follows:

1. Nearly all invertebrates set in relatively large numbers in coarse and fine sand.

2. Polychaetes, rhynchocoels, starfish and the bivalve, Nucula proxima, set in relatively large numbers in fuller's earth, whereas amphipods, the surf clam, Spisula solidissima, tellin clam, Tellina agilis, and moon snail, Lunatia heros, generally avoided it.

3. Polychaetes, rhynchocoels, starfish and S. solidissima set in relatively large numbers in sand containing high sulfide-low oxygen, whereas amphipods, N. proxima, T. agilis and L. heros generally avoided it.

4. With few exceptions, invertebrates had very low relative numbers in sediments from 1) the sewage dumpsite; 2) an elevated carbon site ~3 n mi (5.6 km) north of the dumpsite; 3) fuller's earth plus domestic sewage sludge; and 4) fuller's earth plus sewage containing industrial wastes. An exception was the starfish, which was the least sensitive to sediment types; they settled in nearly equal numbers in all sediments, except fuller's earth plus domestic sewage sludge. S. solidissima was relatively abundant in sediment from the sewage dumpsite, in agreement with its presence in the sand with sulfide. Spisula larvae appear to select for sand-size sediments, with other cues less important.

5. Considering the three grain sizes by themselves, polychaetes, rhynchocoels and starfish occurred in about equal numbers in all three; amphipods were numerous in coarse and fine sand, but scarce in fuller's earth; S. solidissima settled in the largest numbers in coarse sand, with intermediate numbers in fine sand and smallest numbers in fuller's earth; T. agilis and L. heros showed nearly the same pattern as S. solidissima.

The results show that many Bight invertebrates have larvae which can select various bottom substrates and avoid other substrates for setting. Invertebrates set in almost the same low numbers in domestic sewage sludge as in similar sewage sludge containing industrial wastes; thus, it appears that

domestic sewage sludge by itself is extremely noxious to setting invertebrates and the industrial wastes may have relatively minor additive importance in repelling settling invertebrates larvae. Two characteristics of sewage sludge which some invertebrates seem to avoid are: 1) its consistency, being somewhat similar to mud (some invertebrates avoided fuller's earth) and 2) the high sulfide-low oxygen it generates (some invertebrates avoided the sand with high sulfide-low oxygen). These results are tentative until data are available for more treatment replicates.

The purpose of the 1984 tray studies was to separate some of the major components of sewage sludge and test them separately in the experimental trays. A test showed that the liquid portion which comprises about 95 percent of the sludge's volume is highly noxious to settling invertebrates, whereas inert cellulose which represented the inert organic matter in sewage is non-toxic. (Averages from two replicate sediment trays were: 130 polychaetes/tray where the sediments contained liquid sludge, 413/tray containing 5% inert cellulose and 930/tray with 20% inert cellulose.)

The study of surf clam setting and predation showed that: 1) heavy setting and nearly complete mortalities of juvenile surf clams occurred about every year and 2) crabs were the most important predators. At a station off the coast of northern New Jersey, the density of juvenile clams reached nearly 2,400 m^{-2}, and off the coast of western Long Island, it reached about 8,000 m^{-2} in 1980.

The juvenile surf clams had nearly complete mortality before the subsequent spawning season. Most mortality occurred in the fall following setting. At the New Jersey station where we believe that juvenile clams set every year, clams older than juveniles are rarely encountered.

Lady crabs (Ovalipes ocellatus) and rock crabs (Cancer irroratus) were by far the most important predators of surf clams; the moon snail (L. heros) was another predator but had minor importance. At the New Jersey station, the lady crabs were burrowed just under the surface of the sand while feeding on the clams. During one observation, the crabs had a density of 3-4 m^{-2} and each crab had the shells of perhaps 10 to 30 clams which it had crushed and eaten in front of it. The crabs could not burrow into the hard bottom off the coast of western Long Island and prey on surf clams, 5 to 7 cm long, there. We have not determined whether the crabs can prey on clams of that size on softer bottoms.