Aspects of Predation on Hard Clam (Mercenaria mercenaria) Populations in Northeastern U.S.A. Estuaries

by

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Introduction

Commercial landings of hard clams (Mercenaria mercenaria) between Maine and Florida declined nearly eight percent between 1975 and 1985. The decline was due to a decline in hard clam abundance. To gather information on the factors which limit the abundance of hard clams and to pursue the possibility of abundance enhancement, we examined three aspects of predation on juvenile hard clams in 1986 and 1987:

I. Predation in Great South Bay, Long Island, New York and Barnegat Bay, New Jersey.

II. Predation by two shrimp species, Crangon septemspinosa and Palaemonetes vulgarus, and the hermit crab, Pagurus longicarpus.

III. Control of predation using crushed shells.

RESULTS

I. Predation on juvenile hard clams in Great South Bay, Long Island, New York and Barnegat Bay, New Jersey

1. Great South Bay

Studies made in the past showed that predation on juvenile hard clams in the Bay was substantial (MacKenzie 1977), but since the mid-1970s the number of benthic animals has declined enormously. For example, in the mid-1970s, many more oyster drills and mud crabs, both predators of hard clams, were present. In 1975 the density of mud crabs was 3.5/square meter, while that of oyster drills was 1.0 per square meter (MacKenzie 1979). Though these species inhabited the Bay in 1986 and 1987, they were too scarce to be collected in our samples.

The beds were sampled in August 1986 and in August 1987 to determine whether predation of juvenile hard clams had diminished. Samples were taken with a hydraulic suction sampler operated by a SCUBA diver. The sampler removes all hard clams and other invertebrates from within a circle which encloses 0.3 m^2 (3 square feet) and collects them in a mesh bag attached to the exhaust. Three such samples were taken from each of four sites in 1986 and six sites in 1987.

The data showed that the Bay had an large set of hard clams in 1985. The densities of the 1985 generation of clams in 1986 and 1987 are compared in Table 1. The average density at four sites was 12/square meter in 1986. The average density at these four sites was 3.6/square meter in 1987. We attributed the difference in abundance to predation, probably by crabs because

crushed shells of juvenile clams were in the samples. Thus, predation appeared to be substantial in 1986 and 1987. The crab species were not identified.

Table 1. Number of hard clams (1985 generation) collected at areas in Great South Bay, Long Island, N.Y. in 1986 and 1987. Values listed represent the number of clams per square meter. Collections made with the hydraulic suction sampler.

Area	August 16, 1986	August 5, 1987
1.	-	4.8
2.	-	14.3
3.	20.3	4.8
4.	7.2	7.2
5.	0	0
6.	20.3	2.4

On August 16, 1986 the 1985 clams were between 1 and 10 mm long (Fig. 1). On August 5, 1987 they were between 5 and 20 mm long (Fig. 2). Thus, the clams had grown 4-10 mm in a year. Figures 1 and 2 show a 20-mm gap between the 1985 and any older clams present in substantial numbers. From these data, we predict a drop in clam production in the areas sampled after 1989 and lasting for two or more years until the 1985 clams attain commercial sizes. Also, if the 1985 clams survive well until they attain commercial sizes, they will support an increased production over that in 1987.

2. Barnegat Bay

In Barnegat Bay, several hatcheries grow juvenile hard clams in trays for several months and then plant them in shallow beds in the bay where they grow to market size. In the trays and beds, the operators keep the clams covered with screens to protect them from predacious crabs until they are harvested. The clams are destroyed by crabs when they are planted without the screens. Although it was suspected that predation on wild juvenile hard clams was probably heavy on the deeper, public beds and private leases where most hard clams are harvested, no one had established whether it was true.

For this study, we obtained hard clams, 2 to 3 mm long, from a hatchery, marked them with a fast-drying paint (Krylon) and spread them around a stake at each of four sites on July 24, 1986 (Table 2). One thousand clams were planted at each site. The lengths of the clams were about the same as those of wild, 1986 generation clams. We sampled the sites on July 28, September 14 and October 2, 1986 by recovering many of the clams, and recorded mortalities

Figure 1. Length-frequency of hard clams collected from four sites in Great South Bay, Long Island, New York, August 16, 1986. Collections were made with the hydraulic suction sampler.

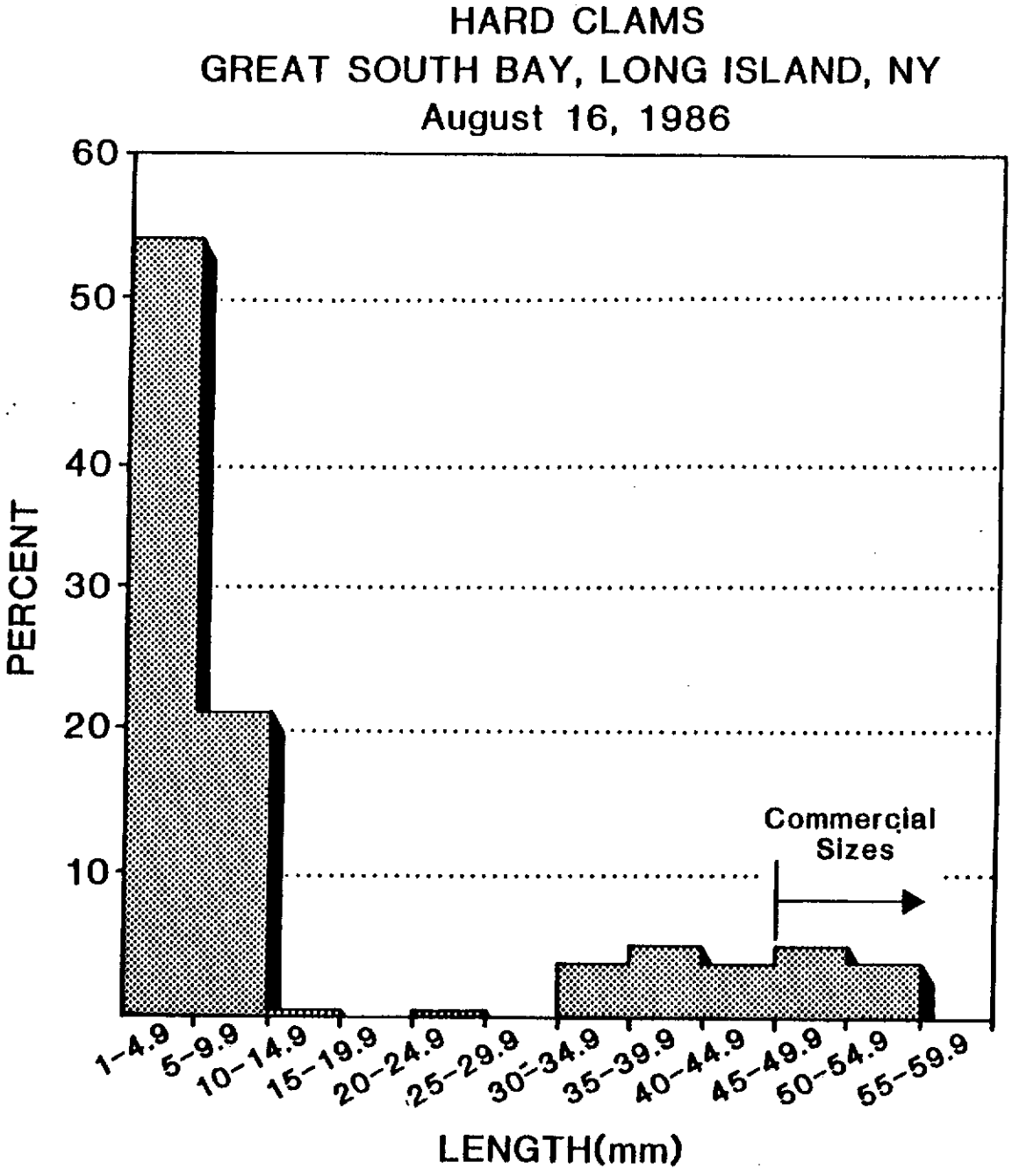
HARD CLAMS
GREAT SOUTH BAY, LONG ISLAND, NY
August 16, 1986
60
50
40
30
20
10
PERCENT
Commercial Sizes
1-4.9
5-9.9
10-14.9
15-19.9
20-24.9
25-29.9
30-34.9
35-39.9
40-44.9
45-49.9
50-54.9
55-59.9
LENGTH(mm)

Figure 2. Length-frequency of hard clams collected from six sites in Great South Bay, Long Island, New York, August 5, 1987. Collections were made with the hydraulic suction sampler.

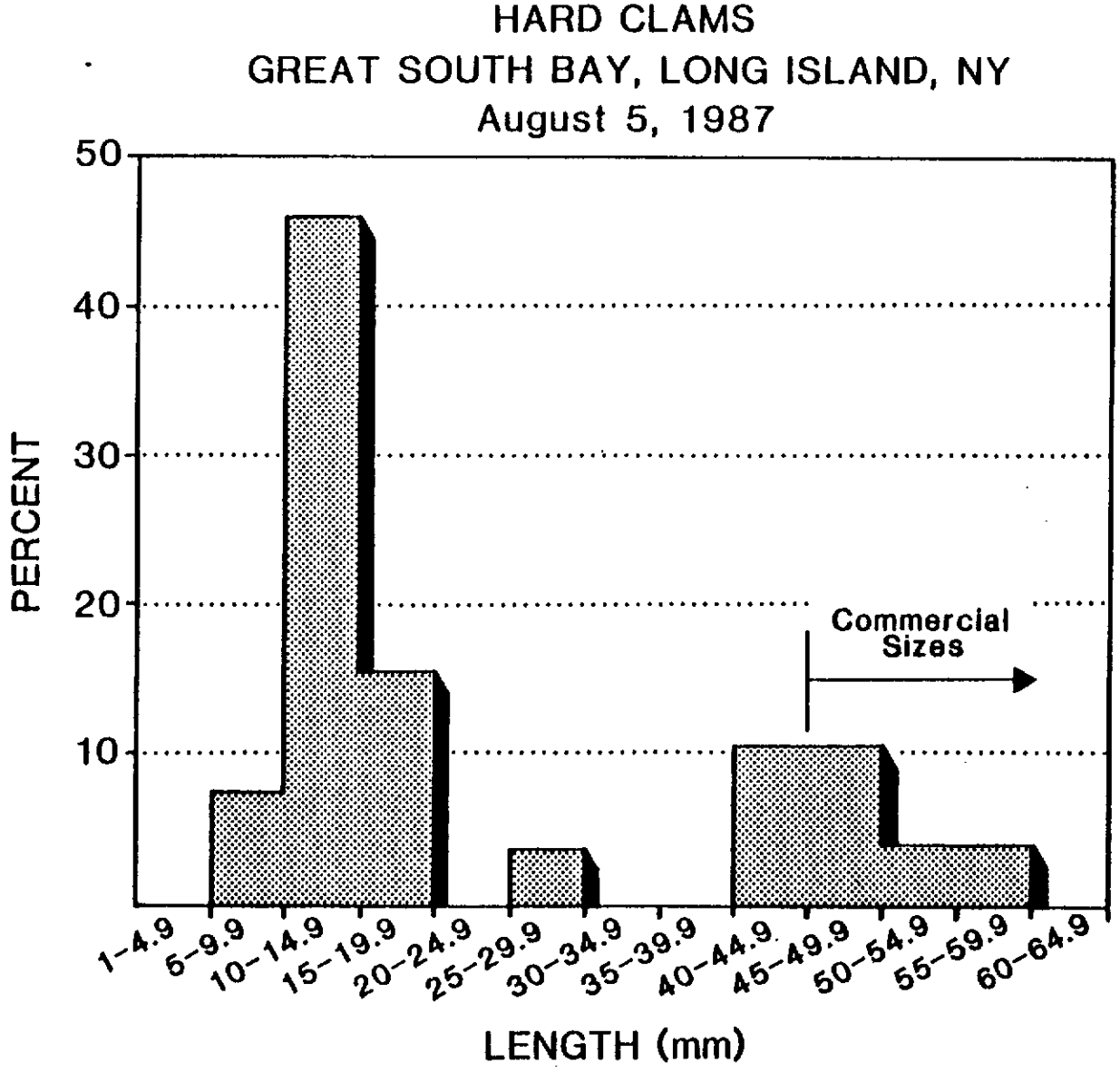
HARD CLAMS
GREAT SOUTH BAY, LONG ISLAND, NY
August 5, 1987
PERCENT
50
40
30
20
10
Commercial Sizes
1-4.9
5-9.9
10-14.9
15-19.9
20-24.9
25-29.9
30-34.9
35-39.9
40-44.9
45-49.9
50-54.9
55-59.9
60-64.9
LENGTH (mm)

Table 2. Percentages of juvenile clams killed by predators at four sites in Barnegat Bay, New Jersey. The clams were planted at the sites on July 24, 1986.

Locations	Collection Dates		
	July 28, 1986	September 14, 1986	October 2, 1986
North of Barnegat Inlet	-	-	75
Parkertown 1.	96	100	-
2.	-	62	-
Goose Bar	-	-	63
Great Bay	-	24	-

Note: All predation was caused by crabs, probably mud crabs, except north of Barnegat Inlet, where about half was caused by oyster drills, half by crabs.
- means no sample taken.

and probable causes (crushed shells showed crab predation and holes showed snail predation).

The marked hard clams showed heavy mortalities (Table 2). For example, at one site in Parkertown, 96 percent of the clams had been killed by crabs only four days after we planted them; within about two months, 100 percent had been killed by crabs. Thus, we conclude that predation on natural sets of hard clams is probably heavy.

In an attempt to determine species of crabs responsible for the clam mortalities, we placed bags of shells at two of the sites to collect crabs. The only crabs collected were mud crabs (Xanthidae). We placed these with small clams in dishes and found that they consumed the clams. A hatchery operator told us that rock crabs (Cancer irroratus) destroyed some of his clams during the winter.

II. Predation by two shrimp species, Crangon septemspinosa and Palaemonetes vulgarus, and the hermit crab, Pagurus longicarpus

Dr. R. Whitlatch of the University of Connecticut announced, at the 7th Shellfish Biology Seminar held in March 1987, Milford, Connecticut, that the grass shrimp (P. vulgarus) is a predator of post-set juvenile hard clams. Dr. M. Gibbons reported in her PhD thesis (1984) that the hermit crab (P. longicarpus) preys on juvenile hard clams on Long Island, New York. These appear to the only two reports that these common inhabitants of coastal bays are predators of hard clams; they are not mentioned in the review of hard clam literature by Stanley (1985). To our knowledge, the sand shrimp (C. septemspinosa) had not been identified as a predator.

We conducted a laboratory test to confirm that the three species collected in New Jersey prey on small juvenile hard clams. For the test, individual adult shrimp and hermit crabs were held with 50 clams, 1 mm long, in 1 L dishes of standing

water. The test were run twice for each species with a different animal each time. Each test lasted 24 hours. In the tests, each sand shrimp, grass shrimp and hermit crab consumed all 50 hard clams held with them within 24 hours.

III. Control of predation using crushed shells

Castagna and Kraeuter (1976) and Lee (1977) have reported that a cover of shells over the bottom protects juvenile hard clams from predation. In addition, interviewed commercial hard clam diggers in Raritan Bay and Barnegat Bay, New Jersey, stated that hard clams are most abundant where shells are abundant.

In 1987 we conducted a test in Barnegat Bay to determine whether a cover of shells would enhance hard clam abundance. We used broken ocean quahog shells, having an average width of about 2.5 cm. We spread the shells over two plots, each 5x5 meters, at a rate of 700 bushels per acre, on July 8, which was about the beginning of the annual period when hard clam larvae settle. The plots were sampled on October 22.

The test did not have a result because juvenile hard clams did not settle in quantity. In fact, only one 1987 generation hard clam was collected in 21 samples taken within and around the two plots. The samples were collected with a hydraulic suction sampler operated by a scuba diver; the sampler collected all material from within 0.3 m^2 of bottom for each sample. One shelled plot had far more juvenile mud crabs (carapace width 5-9 mm) than unshelled control areas around it: 8.8 crabs compared with 1.1 crabs.

If, in the future, it is shown experimentally that a cover of crushed shells does enhance hard clam abundance, the method could be applied in Barnegat Bay. Many thousands of bushels of these shells are available as a waste product from New Jersey plants which process ocean quahogs (Arctica islandica) and surf clams (Spisula solidissima) each year, and many acres of hard bottom are available for spreading the shells in the bay. More than half of the hard clam beds consist of mud bottom which will not support a single layer of crushed shells, however, and thus a different method will be needed to control predators on them.

Literature Cited

Castagna, M. and J. N. Kraeuter. 1976. The aggregate protection method of culturing hard clams, Mercenaria mercenaria. 10th European Symposium on Marine Biology, Ostevd, Belgium. Vol. 1:33 (Abstract).

Lee, 1977. Use of shells found a good way to save clams from predators. Nat'l Fisherman 57(1): 11A.

MacKenzie, C. L. Jr., 1977. Predation on hard clam (Mercenaria mercenaria) populations. Trans. Am. Fish. Soc. 106(6): 530-537.

MacKenzie, C. L. Jr., 1979. Management for increasing clam abundance. Mar. Fish. Rev. October. pp10-22.

Stanley, J. G. 1985. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic) --hard clams. U.S. Fish Wildl. Serv. Biol. Rep. 82 (11.41). U.S. Army Corps of Engineers, TR EL-82-4. 24pp.