Managing Shellfish Resources Under Increasing Pollution Loads[1]

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INTRODUCTION

Increasing human encroachment on coastal areas imposes an evergrowing environmental insult on the nearby marine waters. Homes, industries, and waste handling facilities (including liquid waste and solid waste) contribute pollutants to the aquatic ecosystem. The situation is not likely to change in the foreseeable future. Thus, individuals charged with the management of marine shellfish resources are faced with the problem of how to maintain usable production in the face of the environmental pressures. A case in point is New York State's prosperous shellfish industry.

SHELLFISH PRODUCTION

Of the 16.3 million pounds of hard clams produced in the United States in 1972, New York was the source of more than 52% of them. In 1972, the State's shellfish industry harvested 8.5 million pounds of hard clams (*Mercenaria mercenaria*) worth $13.2 million at the dockside, mostly from Great South Bay (National Marine Fisheries Service, 1973). In addition, the industry harvested 1.1 million pounds of American oysters (*Crassostrea virginica*) worth $2.5 million ex-vessel. Although we have no hard data for the retail value of these products, a realistic estimate suggests at least $150.0 million. Hard clam and oyster production from New York State waters for the past 10 years is shown in Table 1.

Most of the bivalve shellfish were harvested from approximately 425,000 acres of underwater land controlled by the state of New York. (Some underwater land is owned outright by local municipalities and shellfish farms under Colonial grants issued by the British government in the 17th century.) At the present time, about 100,000 acres (24%) are closed because the waters do not meet criteria established for the certification of shellfish growing areas. Each year, additional thousands of acres are closed; in 1973, more than 13,000 acres were closed to the harvest of shellfish.

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Table 1. Shellfish Production and Value in New York (1963-1972)

Year	Hard clams		Oysters	
	(lbs. x 10^6)	($ x 10^6)	(lbs. x 10^6)	($ x 10^6)
1963	5.31	3.58	0.39	0.57
1964	5.40	4.13	0.21	0.31
1965	5.95	5.15	0.20	0.32
1966	6.58	5.79	0.18	0.33
1967	7.07	7.09	0.10	0.21
1968	6.99	7.27	0.17	0.38
1969	7.52	8.18	0.21	0.47
1970	7.90	8.98	0.52	1.07
1971	8.55	10.76	0.78	1.68
1972	8.50	13.23	1.11	2.47

SOURCES OF POLLUTION

One pollution problem unique to the marine region relates to the duck farms located in the eastern portions of Suffolk County. Inadequate treatment of the farm wastes has resulted in the closure of major portions of shellfish waters in these areas because of polluted runoff from duck farms. At one time, there were approximately 35 such farms – most of them located in the extreme eastern part of Suffolk County (Fig. 1). As a result of efforts by the N.Y. State Department of Environmental Conservation (DEC) and the N. Y. State Department of Health, the duck farms were ordered to install waste water treatment facilities. A number of the farms closed, but 28 have installed the necessary treatment equipment. Pollution from the duck farms is now less of a problem than it was in the past, but still continues to exist.

Another form of pollution affecting the shellfish grounds is domestic sewage. It comes from a variety of sources and is linked to the rapid development of the Nassau/Suffolk Counties portion of Long Island. Suffolk County (1970 population, 1.1 million), for example, has a population growth rate of 3.3% annually. This is in contrast to the national population growth of 0.8% annually. In Nassau County (1970 population, 1.4 million), the population is fairly stable, since this county was developed as a "bedroom community" of New York City shortly after World War II. The handling of domestic sewage is different in the two counties. Flynn (1972) reports that in Nassau County, 55 to 60% of the population is served by sewers. In Suffolk County, only 7% of the population is served by sewers. Thus 93% of the residents dispose of their domestic waste water in the ground with cesspools or septic tanks. Some Suffolk County residents are served by small municipal sewage treatment plants. In addition, the county health department requires treatment plants where the volume of domestic waste water is more than 30,000 gallons per day (GPD).

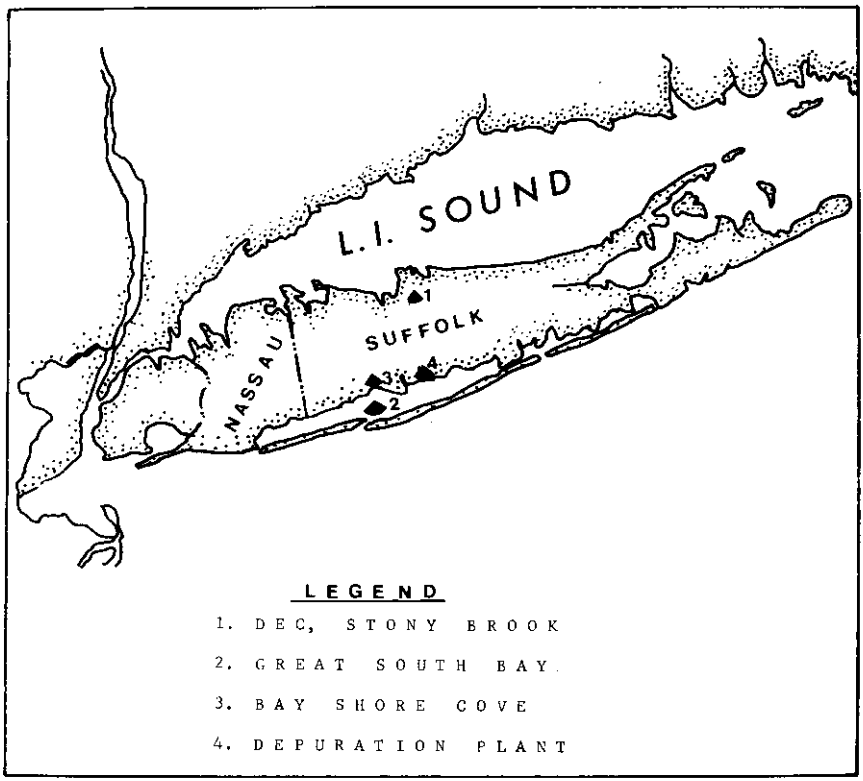

Fig. 1. The Long Island, New York area showing the locations mentioned in the text.

Many builders of tract homes construct small sewage treatment plants as part of the housing development to meet the county requirements. A typical plant handles 300,000 GPD, with secondary treatment, and 90% removal of solids. The chlorinated effluent may be discharged to a lagoon or to cesspools. It receives no further treatment and the liquid percolates through the sandy, unconsolidated glacial till that comprises the Long Island substrate.

One area, Bay Shore Cove, has been of considerable concern to DEC. The area produces a large volume of hard clams, but the coliform counts in the cove have been quite high. A massive, one-day project, termed "Operation Big Flush," was initiated by DEC to determine the possible presence of illegal sewage outfalls into the cove waters. Fluorescein dye was flushed down all of the known toilets around the perimeter of the cove in a 6-hour period. However, none of the dye showed in the water. It was suspected then that the coliforms probably originated in street runoff.

Much of the storm water runoff from streets and parking fields in Nassau and Suffolk Counties drains into recharge basins. There are more than 2,000 of these basins on Long Island, varying in size from a few hundred square feet up to several acres. The basins are excavated to a depth of 15 to 20 feet, and are

designed to allow the storm water to percolate rapidly through the soil to the ground water table. A few of the recharge basins were excavated over clay lenses and the water drains out very slowly. They become, in effect, nearly permanent ponds. The rest, however, drain rapidly; the water is exposed adequately to air and light and the herbaceous vegetation that flourishes on the bottom and sides serves to take up nutrients in the runoff. Much more of the runoff, however, drains into streams that discharge into the bays, or flows directly into the bays. We believe that a major source of the coliform bacteria in street runoff is the feces of dogs and other animals. An informal survey of the Great South Bay "water shed" indicated a population of 80,000 to 100,000 dogs. An average dog can produce about 4 ounces of feces per day (James Redman, personal communication). Thus, there is the possibility of approximately 10 tons of dog feces per day impacting the ecosystem in the bay. Admittedly, not all of the dogs defecate on the roads or parking fields. Nevertheless, substantial numbers of them probably do so.

Analyses of the bacterial content of street and parking field runoff were made in 1972 and 1973 (Redman, 1973). Some extreme values from these studies (Table 2) include: total coliform, 920,000 MPN/100 ml[2]; fecal coliform, 350,000 MPN; *E. coli,* 350,000 MPN; fecal streptococcus, 1.7 million MPN.

In addition to the bacterial contamination of the water, there also is contamination from pesticides and heavy metals. However, most of the values are well below the Food and Drug Administration (FDA) guidelines. For hard clams from New York waters, Butler (1973) reported DDT maximum residues of 201 parts per billion (PPB) and dieldrin, 132 PPB. Analyses for nine pesticides (Foehrenbach, 1972) showed similar low residues.

Table 2. Bacterial Content* of Street Drainage Samples Collected during Rainstorms in Suffolk County

Date	Location	Total coliform	Fecal coliform	*E. coli*	Fecal strepto-coccus
Feb. 3, 1972	Street, Sayville	22.0	0.8	0.3	----
Mar. 3, 1972	Street, Patchogue	130.0	130.0	130.0	110.0
Mar. 3, 1972	Street, Patchogue	3.3	0.3	0.3	49.0
Mar. 22, 1972	Street, Patchogue	4.9	0.2	0.2	240.0
May 9, 1972	Street, Patchogue	920.0	110.0	70.0	17.0
May 9, 1972	Street, Patchogue	540.0	350.0	350.0	110.0
Nov. 8, 1972	Street, Patchogue	160.0	7.9	7.9	54.0
Nov. 14, 1972	Street, Brookhaven	230.0	11.0	4.6	1,700.0
Apr. 9, 1973	DEC parking field	160.0	< 0.1	< 0.1	< 0.1

* MPN/100 Ml x 10^3

[2] Most probable number per 100 milliliters.

CLEANING UP THE WATER

New York State's intensive Pure Waters Program has resulted in the improvement of water quality in the Marine District.[3] We have seen, for example, the restored presence of a variety of organisms in the East River and Hudson River. Both rivers had heretofore been widely considered as nearly open sewers. It is anticipated that continuation of the cleanup effort at all levels of government will result in marked improvement in water quality throughout the State's Marine District. But, at the present time, we are faced with managing the shellfish resources under increasing pollution loads that result from the growth of human population that outraces the growth of waste water treatment facilities.

WORKING WITH THE PROBLEM

One management effort this Department embarked on was a study of the depuration of hard clams. It was felt that the depuration process which has been successful in the New England states would enable the shellfish industry to utilize hard clams from restricted waters. Restricted waters are defined as those where the coliform MPN does not exceed 700 per 100 ml, and not more than 10% of the samples exceed an MPN of 2,300 per 100 ml (Public Health Service, 1965).

A pilot plant for hard clam depuration was operated with partial funding under Public Law 88-309. It was set up in a facility on Great South Bay and initially used water drawn from the bay and sterilized under a bank of ultra violet lamps. Very soon after the project started, this method was abandoned and water was drawn from a saltwater well. The well provided a flow of 30 gallons per minute of a uniform temperature and salinity year-round (54.5° to 55.5° F., 24.0 to 25.5 parts per thousand) and bacteria free. The results of the project (MacMillan and Redman, 1971) indicated that the hard clams were cleansed within 48 hours sufficient to meet the National Shellfish Sanitation Program requirements.

Although there are no commerically operated depuration plants for hard clams in New York State at the present time, we are prepared to consider applications for the use of this process by private concerns. There is one commercial depuration plant for the treatment of soft clams (*Mya arenaria*) on Long Island. This plant receives laboratory support from DEC at Stony Brook for bacteriological monitoring of the process.

The National Shellfish Sanitation Program also provides for the transplanting or relaying of shellfish from restricted or prohibited areas to approved areas. Once the shellfish are transplanted, they must remain in the approved area long enough to cleanse themselves of polluting bacteria. The time interval is determined by hydrological and bacteriological factors and the species involved. In New York State, 30 days is the usual cleansing period. This Department initiated

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[3]Legally defined as, "... the waters of the Atlantic Ocean within three nautical miles from the coast line and all other tidal waters within the state, including the Hudson River up to the Tappan Zee bridge."

Table 3. Hard Clams Transplanted in New York under Supervision of DEC (1964-1972)

Year	Bushels ($\times 10^3$)
1964	10.9
1965	20.7
1966	55.7
1967	48.3
1968	11.8
1969	5.5
1970	0.6
1971	—
1972	14.5
Total	168.0

a transplant program in 1964 and to date, 168,156 bushels of hard clams have been transplanted (Table 3).

Transplanting serves a variety of purposes. It makes available a usable marine resource that would otherwise be wasted (Fig. 2). It reduces the additional

Fig. 2. Baymen harvesting hard clams in Town of Islip waters. This was the day the area was opened one month after 12,000 bushels of clams had been transplanted here.

expense of patrolling the closed areas by DEC law enforcement officers. And it reduces the possibility of a public health hazard that might arise if clams illegally removed from the closed areas were placed directly on the market.

The shellfish industry has eagerly entered into agreements with the State of New York to carry out transplant operations. In addition, this year, the Long Island towns of Islip and Babylon together embarked on a transplant program that was funded equally by the towns and the National Marine Fisheries Service (NMFS) under PL 88-309. Throughout all of the transplant operations, biologists, technicians and law enforcement officers from DEC personally supervise the harvest and subsequent relaying of the shellfish. In addition, the officers patrol the relay area which is closed to harvest during the 30-day cleansing period and the water and shellfish are monitored by DEC laboratory personnel.

In 1973, DEC sponsored state legislation which encourages the shellfish industry to make maximum use of the available clean shellfish waters. Briefly, the legislation (Section 13-0316 of the N. Y. State Fish and Wildlife Law) provides a permit system for the operation of shellfish hatcheries. The permit allows the hatchery to traffic in seed clams and oysters and other products of their operations. Such trafficking had heretofore been specifically forbidden. In addition, the law clarifies a previously misinterpreted law so that off-the-bottom culture of shellfish is now permitted.

FUTURE PROSPECTS

Demographic projections for Suffolk County suggest a doubling of the population by the year 2000. This rapid growth will assuredly result in continued and increasing environmental insult. The N. Y. State Pure Waters Program and the various programs carried out at other governmental levels are proceeding rapidly to maintain and, where possible, improve marine water quality. We probably can expect to see additional closures of presently open shellfish producing waters. However, through the continuing management efforts of the Department of Environmental Conservation, and the cooperation of the shellfish industry, we will be able to continue harvesting good quantities of high-quality shellfish products for the consumer.

ACKNOWLEDGMENT

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