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THE RHODE ISLAND QUAHOGGER:

CANDIDATE FOR THE LIST OF ENDANGERED SPECIES?

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APRIL 28, 1981

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Introduction

It is the hypothesis of this paper that today the livelihood of the independent Narragansett Bay quahogger is faced with two potentially dangerous threats: water pollution in upper Narragansett Bay and the prospect of an expanding aquaculture industry in the lower bay. Unless the state of Rhode Island properly interprets and enforces existing state legislation to protect the quahoggers interests, his very livelihood will be jeoprodized.

This paper will examine the legal, political, economic, and environmental affects of water pollution in upper Narragansett Bay and an expanding aquaculture industry in the lower bay in their relation to the Rhode Island quahog fishery. Based on these findings a recommendation will be made as to the best course of action for the state of Rhode Island to pursue on these controversial issues.

In choosing a topic, one of my primary concerns was to focus on a local issue dealing with a fishery native to Rhode Island. The quahog industry immediately came to mind. Since living in Rhode Island for the past year and a half, I have become increasingly aware of the massive influx of pollutants into upper Narragansett Bay and its adverse effects on the Rhode Island shellfishing industry. I have also become aware of the increasing concern among independent Rhode Island quahoggers over the prospect of an expanding aquaculture industry in lower Narragansett Bay. I live in the immediate vicinity of the Blue and Gold Sea Farms and have always been curious about the many facets of opera-

tion involved in this recently introduced industry to Narragansett Bay.

Publicity through articles run in the Providence Journal and Newport Daily News have increased public awareness of these important issues. Over 3,000 Rhode Island citizens earn their living through the harvesting of quahogs. I feel that the magnitude of the importance of these issues and their subsequent effect on the people involved is such, that a paper on the subject matter will provide further insight into the dilemma and hopefully produce some viable alternative solutions to the problems.

My first step in conducting the research is to establish the status quo with regards to the Rhode Island Quahog Industry in terms of the number of individuals engaged in the trade, yearly catch, market value, state revenue acquired, past, present, and future trends in the industry, and the area of Narragansett Bay subject to the harvesting of quahogs.

I will then examine the effect of water pollution in upper Narragansett Bay on the Rhode Island Quahog Industry in terms of its legal, political, economic, and environmental impacts. Having analyzed the data dealing with the effects of water pollution in upper Narragansett Bay and the Rhode Island quahogger, I will state my findings and recommendations.

Next I will examine a more suttle, but potentially greater threat to the independent Rhode Island quahogger; specifically an expanding aquaculture industry. I will first examine the history of aquaculture in Narragansett Bay ranging from its initial inception with the oyster industry in the late 1800's to its

present day status.

I will then study the Blue and Gold Sea Farms located in Middletown in light of its legal, political, economic and environmental impacts upon the Rhode Island quahog industry. In addition, I shall examine a recent hearing before the Rhode Island Coastal Resources Management Council concerning an aquaculture permit application by Mr. William K. Macy to establish a mussel farm off the west coast of Prudence Island. Having analyzed the data associated with the possible effects of the establishment and expansion of aquaculture in Narragansett Bay and its relation to the Rhode Island quahogger, I shall state my findings and recommendations.

Today over 3000 Rhode Island residents rely whole or in part on the Rhode Island quahog fishery, the largest commercial fishery in the Narragansett Bay, as a primary means of income and family support. Although catches now are much smaller than catches in the 1950's, commercial landings have increased during the last four years as depicted in figure 1. In 1978 nearly two million pounds (meat weight) worth $4.3 million (ex-vessel) were reported as landed in Rhode Island.[1] This in itself is a conservative estimate as it only reflects that portion of the annual harvest that was reported to the National Marine Fisheries Service.

Most of the quahog catch is taken from Narragansett Bay by hand rakes. Hand rakers fish with tongs or a bullrake on the end of a long pole operated from small open skiffs. Tongers work waters up to 20 feet deep while rakers can work up to 50 feet deep with long aluminum poles.

Robert Rayhill, president of the Rhode Island Shellfisherman's Association, which currently has 158 members, has predicted that the number of state residents dependent on commercial quahogging for a living has and will continue to grow. Data provided by the Department of Environmental Management in figure 2 and 3 concerning the present day $8 million Rhode Island quahog industry substantiates Mr. Rayhill's prediction.

A number of things are immediately obvious upon examination of these figures. First is that the number of individuals engaged in quahogging is increasing in every category of license application. The current trend is such that more and more individuals

under 65 years of age previously engaged as shore diggers are investing in boats and moving into a different license category. This implies that the resource is getting scarcer to obtain in shallow waters and also, that its market value is increasing to the point where it offsets the cost of capital investment in a boat. Thus we see the start of a vicious cycle in terms of supply and demand and market prices. As the resource gets scarcer, both demand and price increase providing even increased pressure on a diminishing resource.

The summertime recreational fishery exerts a fairly minor pressure on quahogs, since recreational fisherman do not usually invest in a boat and raking equipment. Instead they work the shallow waters near shore and are content with a much smaller catch (the leagal limit is one half bushel per day). Currently the Department of Environmental Management issues six types of commercial licenses as depicted in figure 2. These annual licenses run from 1 October to 3 September.

Commercial handrakers are restricted to a legal limit of twelve bushels of quahogs per day. The smaller quahogs are the most sought after since they bring the better price. The catch is divided into three size categories: littlenecks, 1 1/2"-2 1/8"; cherry stones, 2 1/8"- 2 1/2"; chowders, greater than 2 1/2" (measured fron the hinge to the shell margin). The 1979 ex-vessel prices offered per pound were as follows: 80¢ for little necks, 15¢ for cherry stones, and 10¢ for chowders. As the size decreases, the market value is greater because the small clams are prized for serving raw on the half shell.[2] The price per pound of little necks in the summer of 1980 ranged between 90¢ and a dollar per

pound. Today the market will pay in excess of a dollar per pound for the commodity. The result is that quahog beds situated in the lower part of Narragansett Bay are gradually becoming depleted due to constant harvesting pressure.

In 1978, Rhode Island quahog landings were 10% of the U.S. harvest. In 1979 the state recieved $31,239 in license sales. In 1980, $43,028 was generated in commercial license fees. Quite obvious is the fact that the Rhode Island quahog industry plays a major role in the livelihood of Rhode Island residents. We will now examine the effects of water pollution in the upper Narragansett Bay on the Rhode Island quahog industry.

Quahogs are abundantly distributed over the bottom of Narragansett Bay, particularly the West Passage, Greenwich Bay, the Upper Bay, and the edges of the Providence River. (Figure 4) They feed on phypoplankton which they filter from the water as they pump it through their siphon tubes and over their gills. They spawn in the summer from mid-June to mid-August, when water temperatures rise over 60 F. A female releases a total of about two million eggs each season which metamorphose into planktonic larve that are suspended in the water ten to twelve days before settling on the bottom.[3]

It is a well known fact that some of the richest quahog beds are located in the Upper Bay and lower Providence River region. Several surveys have been taken in past and recent years in order to estimate changes in the size of the population, but equipment and survey techniques differ to such an extent that results are not conclusive. The surveys do indicate, however, that there is presently an abundant population of the smaller quahogs which

are the size most valuable for marketing. They are also the size in which most of the reproduction occurs, and therfore most valuable in terms of maintaining a fishable stock.

Many of the prime quahog beds in upper Narragansett Bay have been permanently or conditionally eliminated from the fishery because of pollution in the Providence River from industrial discharges, storm sewer outfalls, and sewage treatment plant effluents. Figure 5 and 6 show the major tributaries that feed into the Providence River and the Upper Bay. According to an environmental impact statement of 1978 pollution in the Providence River and upper Narragansett Bay caused by discharges from the sewage collection and treatment systems of the cities of Providence, Central Falls, and Pawtucket is by far the most severe water quality problem in Rhode Island's coastal waters. The Providence sewage treatment plant at Field's Point is grossly under-equipped to handle the sewage it recieves. The plant was constructed at the turn of the century as a showcase of modern technology and was designed to treat the domestic wastes of 200,000 people or about 50 million gallons of waste water a day. The plant still treats sewage from about 200,000 people in Providence, Johnston, North Providence and parts of Cranston and Lincoln. According to flow-data monitored by DEM the average daily flow was up to 65 million gallons per day. Figure 7 is indicative of the increasing trend of discharge of sewage effluent aggrivated by rainfall even though the population of Providence is decreasing.

The antiquated and failing equipment of the Field's Point sewage treatment plant cannot provide the level of treatment necessary to meet EPA's minimum requirements for 85% BOD (Biochemi-

cal Oxygen Demand removal). Dry weather flows to the plant exceed the design capacity. The treatment provided does not remove pollutants such as heavy metals contained in the industrial sewage recieved by the plant. The cost of repairs necessary to make the plant meet EPA requirements in 1978 was estimated at $8.5 million. The very extensive network of combined sewer system of Providence, Pawtucket, and Central Falls deliver an enormous amount of untreated storm water mixed with raw sewage to the Field's Point plant during rainy weather. Since the treatement plant cannot treat the excess volume of storm water, during high storm runoff, bypass valves are opened that divert storm water and sewage directly into the Providence River. As a result, surface waters of the Upper Bay become contaminated with coliform bacteria above levels set by federal standards for shellfishing areas.

The Providence River which recieves an influx of water from the polluted Pawtuxet River is also a major source of heavy metals and hydocarbons entering the Narragansett Bay. It has been estimated that 30% to 60% of the suspended hydrocarbons entering Narragansett Bay from the Providence River are discharged from the Field's Point sewage treatment plant. The major input of metals and industrial waste to the bay is attributed to discharges in municipal sewage systems from the jewelery and metal working industries in the Providence area. Industrial effluents from some 93% of the states industries eventually enter Narragansett Bay. The Blackstone Valley District Commission Treatment Plant also contributes a substantial amount of pollutants into the Upper Bay. Municipal treatment plants such as Field's Point simply cannot adequately treat industrial effluents. Toxins such as heavy metals,

hydrocarbons, organic solvents and salts are only partially removed in sewage treatment plants. As a result, they disrupt the treatment process of domestic sewage, contaminate the sludge and thus create disposal problems and further degrade the water quality of the Providence River and Upper Bay.[4] PCB concentrations are also highest in the sediments near the outfall from the Field's Point plant although they are not at a hazardous level at present. Metals, hydrocarbons and PCBs accumulate in sediments; pollution will therefore, continue to be a problem even after discharges have been eliminated.

The FDA has established regulations setting standards for mercury and some pesticides, PCBs (2.5 ppm) and kepone (.1 ppm). Concentrations in quahogs harvested from the Upper Bay and lower Providence River are below these standards. Since metals are concentrated in sediments and accumulated in organisms to greater concentration than they are found in the water, they may constitute a health hazard even though concentrations in the water are relatively low. With this in mind, the Federal Food and Drug Administration has set 'alert' levels for quahog tissue as a forewarning to public health officials to check an area more thoroughly if such levels should occur. These levels are not legally binding, but serve as a warning mechanism. Although metals are found in high concentrations in clams taken from the Upper Bay than in those farther down bay concentrations are well below the alert levels, with an occasional exception of high copper and chromium levels in clams in the Providence River. High concentrations of oil have been found in clams from the Upper Bay.[5]

Another source of water pollution in Narragansett Bay is an influx of polluted waters from Mt. Hope Bay, which services the Fall River sewage treatment plant. The Fall River plant provides only primary treatment which like the Field's Point plant has a combined sewer system which discharges untreated storm water and raw sewage through an overflow system.

As a result of this pollution over 5,600 acres of the Providence River north of a line drawn from Conimicut Point through Conimicut Light to Nyatt Point have been permanently closed to commercial shellfishing since the 1950's. (Figure 8) This line has been extended down to Rocky Point as of 1980. (Figure 9) Those beds which lie south of this line and north of a line drawn from Warwick Point through the northernmost tip of Patience Island to Popasquash Point (an area of approximately 9,400 acres) are conditionally open/closed to shellfishing. The conditional nature of this regulation takes into account the effects of excessive rainfall and resultant overflow of combined sewers, urban runoff, hydraulic, and treatment problems at the treatment facility, and bypassing of the treatment facility. After rainfall of greater than 1/2" in any 24 hour period, the shellfish beds of this conditional zone are automatically closed for seven days. A rainfall of greater than 1" in any 24 hour period results in a ten day closure. Reopening is contingent upon acceptable coliform MPN on the opening day. Unacceptable MPN results in a continuation of the closure. Figure 10 and 11 give an indication of how rainfall has effected closure of the conditional area in recent years.

During recent years, the conditional area, which comprises about 50% of the hard shell clam resource in SA waters (salt water

in which shellfishing and bathing are permitted) has been closed for increasingly long periods of time due to equipment failures at the Field's Point sewage treatment plant. According to a DEM report (Sisson, 1976), areas in the lower Providence River and conditional areas of the Upper Bay that are presently closed to shellfishing could produce an annual harvest of about six million pounds, worth some $1.5 million (ex-vessel 1979 prices). Using a multiplier of 2.76 for Rhode Island quahogging (Callaghan and Comerford, 1979), this harvest could contribute about $4 million annually to the state's economy through direct, indirect, and induced multiplier effects.[6]

Officials at DEM and the Federal Food and Drug Administration, which oversees the shellfish sanitation, tests water samples for the presence of coliform bacteria, which are harmless in themselves but indicate the presence of more toxic bacteria or viruses in the water. The water quality standards also measure dissolved oxygen levels.

The shellfish standards (SSGA 765) states that in class SA waters coliform levels must not exceed a Median Probable Number (MPN) of 70 per 100 ml of water. This is a public health measure which is designed to minimize the possiblity of a chance spread of disease through the eating of shellfish that have been contaminated by sewage. Those portions of Narragansett Bay with a MPN under 70/100 ml are, therefore, unconditionally open to shellfishing. SB water (water suitable for bathing, other recreational purposes, industrial cooling, and shellfish harvesting for human consumption after depuration) must not have coliform levels in excess of a MPN of 700/100 ml. Class SC is suitable for fish and wildlife

habitat, recreational boating, and industrial processes and no coliform levels are specified. Because of high coliform levels and low oxygen concentrations, the Providence River is less than SA, and is classified SC for much of the northern section. Consequently the Providence River north of Conimicut Point has been permanently closed to commercial shellfishing since the 1950's.[7]

Since commercial shellfish are marketed out of state, the DEM establishes the closure boundaries with FDA officials whose mission is to protect public health rather than manage the environment. As a result, the areas closed to shellfishing include a conservative safety margin. For instance, beds are closed on the basis of coliform counts taken from samples of surface water. In the Providence River surface waters have much higher concentrations than either the bottom waters or the quahogs themselves. In 1966, Dr. Andreas Holmson of the University of Rhode Island undertook a study of the practicality of quahog depuration. Quahogs contaminated with high levels of coliform in need of depuration could not be found for experimentation in the Upper Bay during non-summer seasons. Yet the area is closed to shellfishing.[8]

Irate shellfisherman argue that the state is being too cautious in its designation of polluted waters especially in light of the fact that the coliform standard is based on an examination of water samples rather than the quahogs themselves. DEM officials themselves state that although this water sampling method is controversial and inconclusive, it is the most practical way to gauge the level of contamination to which shellfish are exposed. They argue that the testing of quahogs themselves would be endlessly time-consuming and costly.

Many quahoggers do not take the state's designation of polluted waters seriously, reasoning that quahogs a few hundred yards over the closure line cannot be more contaminated than those in legal waters. Shellfish dealers agree that identifying quahogs taken from marginal waters is impossible. Warren Finn, whose Finn's Sea Foods in East Greenwhich is the state's largest shellfish dealership , is quoted as saying, "If they go up the Providence River and get those that are different colors, you can tell, but for much of it you can't tell the difference."[9] The rationale of a large number of Rhode Islanders who earn their living quahogging in Narragansett Bay is perhaps best summed by Dennis W. Nixon, attorney of the Rhode Island Shellfisherman's Association, when he said, "No one ever died from eating a bad Narragansett Bay shellfish. The government's been so extra ordinary careful, it's overkill. They've got a 300 percent safety margin that's not good for the consumer or the fisherman." Mr. Nixon argues that authorities are insensitive to the economic problems afflicting the state's 3,000 commercial quahoggers. "They don't see the very pressing need perhaps to work in the borderline waters.", he said.[10]

The enforcement of the shellfishing ban in upper Narragansett Bay has proven to be a major headache to DEM enforcement officials. The closing of upper Narragansett Bay to shellfishing has resulted in the depletion of the quahog beds of the lower bay, lessening their productivity, with an average quahogger digging anywhere from $30 to $200 a day. On the other hand, a great deal of money can be made in polluted quahogging in the Upper Bay where it is possible bull-rake $500 an hour. Ther have been claims by some individuals who quahog illegally at night of profits ranging from

$2,000 to $3,000 a week. Robert Rayhill, president of the Rhode Island Shellfishermans Association, remarked, "Guys working polluted waters scare the people. They think, jeez maybe I got some that got to the market."[11]

In December and January of last year a record of nearly sixty shellfisherman were arrested by enforcement officials of the state Department of Environmental Management and hauled into court. This was more, according to Superior Court Judge Albert E. DeRobbio, than he had seen in the previous several years combined.

Rhode Island's strict enforcement laws have traditionally acted as a major deterrent to illegal shellfishing. Quahogging in closed waters is a misdemeanor as a first offense and punishable by fine, and a felony thereafter. Quahogging after dark and before dawn is a felony. In 1980 higher fines were implemented in response to the economics of quahogging. "In the past, when fisherman wer getting 30¢ or 40¢ a pound, $50 fine was pretty serious," according to Captain Albert Judge of DEM's enforcement division. "Now the price (in 1980) is 80¢ or 85¢; they make so darn much, a $300 fine doesn't mean anything." This past winter the courts and DEM considerably toughened their stand on penalties, suspended fishing licenses, and imposed higher fines and impounded much more equipment. In 1980 DEM impounded at least six boats whereas in 1979 the state only impounded two.

The case of Joseph W. Bennett is an example of how the state is cracking down on illegal quahogging. Bennett made his first court appearence on January 25, 1980 and pleaded no contest to charges of illegal quahogging on December 28 and January 18. He was fined $600. On March 18, 1980 he was arrested again.

Superior Court Judge Albert E. DeRobbio threw the book at him. He was fined $500 and was sentenced to jail for thirty days, making him the first quahogger to do time for illegal fishing. After he got out on April 16, District Court Judge Victor J. Beretta ordered him to forfeit his boat, a 19 foot Cape Codder with a swift 140 horsepower engine, typical of the overpowered boats used in the illegal quahog trade. Bennett's boat was worth over $8,000. Judge Beretta called him a hazard to the health of Rhode Island who had threatened quahog consumers with an epidemic of hepatitis, the most serious malady traceable to contaminated shellfish. Under state law, DEM can decide whether to keep a forfeited craft or put it up for auction, in which case its original owner has the right to submit the first bid. Bennett's greatest fear was that his shellfishing license would be lifted. The 19 year old Bennett who has fished on his family's boats since he was eight and left Toll Gate High School after tenth grade to harvest quahogs full time, remarked, "I'd like to know what they expect me to do for a living? Fishing is my whole life. I can't work in a factory after working outdoors my whole life. I'd be dead."

Upon being informed that his boat was forfeited Bennett remarked, "I'm done, I'm all done." With two years of a suspended sentence and one year of probation ahead of him, he said, The consequences of being accused of poaching by a warden, even unjustly, are too great. He remarked, "What if I get my white Cape Codder back? There are four of them in Apponaug Cove alone to be confused with me. What if I buy a gray skiff? There are a couple of hundred of them on the water." For now, Bennett harvests lobster from his father's boat through September, when his father

returns to quahogging. That should earn him enough to maintain the mortgage on his two year old Warwick house and the loan on the boat he once owned. "I'm not going back to the Adult Correctional Institute for two years. There are animals in there. It was horrible."[12]

Findings and Recommendations

1) Government recommendations closing shellfish beds on the basis of coliform concentrations in surface waters are too restrictive. Rarely do fecal coliform levels in the quahogs in the Upper Bay and the lower Providence River exceed FDA market standards. Closure should be based on shellfish meat samplings vice routine water samplings. In this way samplings would be more indicative of the actual state of the resource. As a result, more of the most productive beds in the bay might be safely opened to fishing.

2) Interstate cooperation with the state of Massachusetts is essential if the planning and implementation of a pollution abatement strategy is to succeed in Mt. Hope Bay.

3) More information is needed on the impacts of both metals and hydrocarbons on fish and shellfish resources, as well as possible human health hazards associated with consumption of contaminated fish and shellfish. It should be noted that depuration may not remove metal or hydrocarbon contamination. More research is needed in this area.

4) Non-point sources of pollution such as runoff, leachate from septic systems and landfills, marinas, and dredgings and spoil disposal are a major source of pollution to Narragansett Bay. There are few regulations governing runoff. Existing regulations for septic systems do not adequately prevent pollutants from entering adjacent waterways, and cannot prevent pollution from older, poorly designed systems.

5) Rhode Island is finally starting to move in the right direction in terms of updating and improving existing publically owned wastewater/sewage treatment facilities. Figures 12 and 13 shows

existing and proposed publically owned wastewater treatment plants in 1977. Today, for the most part, the 1977 proposals and plans have not been realized. Only Cranston has in fact succeeded in upgrading its sewage plant to secondary treatment. Figures 14 and 15 show the location of existing sewage treatment plants and rates of discharge per day. Further upgrading of these sewage treatment plants is necessary, particularly the plant located at Field's Point.

6) As stated previously in this report, the sewage treatment facility at Field's Point is a major source of sewage pollution in upper Narragansett Bay in that it has not provided the secondary sewage treatment for which it was designed. The city of Providence was required by the Environmental Protection Agency to repair the sewage treatment plant to assure the quality of the water discharged into the bay met secondary treatment standards by November 1979. When the city failed to do so, suit was brought by DEM and Save the Bay and in May 1980 U.S. District Court cited the city in contempt for failure to rehabilitate the plant. In April 1980, the plant equipment was still not operable, blowers necessary for aerating the sludge were in pieces, valves were not working, and the activated sludge was not of the correct composition needed to decompose the sewage, an essential step in obtaining secondary treatment. Consequently, the city hired an engineering firm, Krasnoff Associates, to fix the plant. They have made great strides by replacing most of the piping and building new weirs in the setting tanks, subsequently improving the quality of the treated water discharged to the Upper Bay. This is encouraging. It at least shows that the EPA, DEM, and concerned citizenry

through a concerted effort can force a city such as Providence into action on the issue of pollution.

There is still a great deal of antiquated equipment that needs to be replaced. Aeration beds need to be repaired and the beach flow of Providence River salt water into the plant halted before the discharge will be of uniform high quality in compliance of EPA standards. Tide gates that were built to cover the end of the discharge pipes and block river water from flowing back into the system at high tide have rotted or are jammed open. It is estimated that as much as one third of the volume that the plant treats is Providence River water surging back into the system. This could be reduced by repairing the tidal gates.[13]

Another pressing problem mentioned earlier is that since storm water, industrial waste water, and municipal sewage all flow into the same network of sewer pipes. During periods of heavy rainfall the volume of water flowing through the sewer system to the plant rises above plant capacity and is shunted off directly into the river. In addition to the overflow at the plant, there are numerous bypasses throught the piping system that automatically shunt off storm water overflow to some 65 outfalls along the river. These are called Combined Sewer Overflows (CSOs) since they are designed to drain flood waters out of the city by combining it with sewage systems. The state DEM in cooperation with the EPA is concerned about the effect of this urban runoff on water quality in the Upper Bay and has hired an engineering firm to design ways to treat the sewage that is discharged through the CSOs.

CSOs contribute 87% of the 440 million gallons per year of settleable solids that flow to the bay. They are a source of

coliform bacteria and petroleum hydrocarbons as well. According to an FDA survey conducted in 1977, over 117 automatic sewage bypasses in the pipes of the Providence system were clogged and stuck open so that sewage was being discharged directly to the bay before it even got to the treatment plant. Maintenance crews were supposed to have fixed the clogs but there is still considerable dry weather sewage discharge according to a recent survey by Dr. Eva Hoffman of URI.[14]

According to DEM estimates it will cost approximately 115 million to expand and upgrade the Providence sewage treatment plant and construct two holding tanks at the site to process some of the combined sewage overflow. The federal government was expected to contribute 75% of the cost, the state 15% and the local town 10%. Unfortunately, the amount of money these groups now have available for the project falls far short of what is needed. As a result, the Rhode Island state legislature authorized a referendum for an 80 million dollar bond issue in November of 1980 to help make up the cost. The people of Rhode Island came out strong in the polls in support of Proposition 2 thereby reaffirming the fact that they are determined that Narragansett Bay be cleaned up and its former beauty restored. The bond issue will enable a new authority to be created to collect user fees, manage contribution funds and operate the plant.

Having examined the problem of water pollution in upper Narragansett Bay and its impact on the Rhode Island quahog industry, I will now examine an equally potential threat to the independent Rhode Island quahogger, namely, the prospect of an expanding aquaculture industry. I shall first examine the history of aquaculture in Narragansett Bay.

The cultivated oyster industry was once one of the state's most important marine businesses in terms of aquaculture. In early colonial times, the Upper Bay produced exceptionally abundant oysters. Productive natural oyster beds at one time covered the entire upper half of the Providence River extending into the cove next to the railroad station. One of the best beds, known as Great Bed, covered 160 acres south of Field's Point. The Seekonk River produced good oysters regularly even through the 1800's. Schooners from Welfleet, Massachusetts used to get seed from Narragansett Bay to transplant in their beds.[15]

During the 1800's, most of the natural oyster fishing was replaced by a flourishing oyster culture industry in the bay, in which seed had to be imported from other states. Starting in 1844, sections of the bay were leased for oyster growing. As many as half a million bushels of seed were transported annually from Long Island or other coastal localities in southern New England, and later from the Chesapeake Bay when local seed stocks ran out because of overfishing. Local seed was planted in the best beds such as those off Field's Point, Pawtuxet Cove, Gaspee Point, Conimcut Point, Nyatt Point, Rumstick Point, the Warren, Barrington and Kickamuit Rivers and imported seed from Chesapeake Bay placed on beds in the rest of the bay. There was a regular coastal trade

in oyster seed which were brought up from the Chesapeake to beds in New England.

In 1880 over 1,000 acres of Narragansett Bay were leased from the state of Rhode Island and oysters made up more than half of the total value of all fisheries in Rhode Island. By 1892 oyster grounds were leased all the way up the Providence River and into the Seekonk River (figure 16). Some of the most prized and productive beds were on Starvegoat Island, an oyster bar now covered by fill at Field's Point. The industry peaked in 1910 with 21,000 acres leased which brought $106,839 in fees into the state's treasury. Nearly 1500 people were employed in the industry and 15.3 million pounds of oyster meats were landed that year (Alexander 1966).

Subsequently, the fishery declined through the 1930's primarily due to increasing scarcity and expense of seed stock and the management problems that led to widespread poaching. Other contributing factors in the decline of the fishery were pollution, starfish predators and hurricane destruction. The market and industry outstripped the supply. The source gradually moved from Cape Cod to Narragansett Bay to Long Island to Chesapeake Bay and the industry followed. The last oyster business in the bay closed its doors in 1957.[16]

Recent and on-going aquaculture efforts have met with varying success. Since 1978, shellfish farmers have recieved 'experimental' permits from the state Coastal Resources Management Council for three Narragansett Bay and eleven coastal salt water ponds projects lining the shore of South County, allowing them to fence off portions of the water and attempt to grow mussels or oysters on lines supended from rafts or floats. Figure 17 shows the location

of existing aquaculture sites on Narragansett Bay and the South County shoreline. Of the eleven sites currently in existence all but two are designed as small scale operations or as described by Ronald Smaldone, an ocean industries officer for Rhode Island Hospital Trust National Bank, "in the limbo between a hobby and a commercial venture." The two sites that currently show considerable commercial potential are Blue and Gold Sea Farms located in Middletown and an oyster farm operated on Prudence Island by Luther Blout. Blout's farm is operated on an artificial pond on land he owns privately so its effects on alternative bay uses is minimal while that of mussel farming operation such as Blue and Gold Sea Farms is quite the contrary.

The idea of artifically cultivating the Atlantic sea mussel (Mytelus edulis) is not new. The mussel was considered a delicacy in many parts of Europe and is cultrued extensively in Holland, France, and particularly the Bay of Viga in Spain. In general however, this species, which occurs in abundance in the intertidal and sub-tidal zones throughout New England, is frequently regarded as a pest rather than as a potentially valuable food product. In recent years, most of the U.S. production has been centered in New England, primarily in Massachusetts and secondarily in Maine. From 1960 through 1967, mussel landings in the United States ranged from 3.20×10^5 pounds meat weight valued ex-vessel at $\$3.4 \times 10^4$ in 1964 to 8.03×10^5 pounds valued at 1.01×10^5 in 1967 indicated both an increase in demand and an increase in market price. Ex-vessel prices were approximately 8¢ to 10¢ per pound.[17] Today's retail price is $2.00 per pound.

In 1973, a state agency in Maine began a consumer education

program regarding mussels and the resulting market demand exceeded the capacity of the existing fishery. It is predicted that as market demand continues to expand, natural stocks will be insufficient and aquaculture ventures will be needed. A similar program was conducted in the Pacific Northwest in order to determine the potential marketing of mussels. Results indicate that an underutilized market for mussel exists.[18]

The characteristics of the sea mussel favorable for commercial culture here in New England waters are:

1) The sea mussel is a hardy species, capable of withstanding prolonged exposure to warm and freezing temperatures when established between the tide lines. By means of its byssal threads, it can establish dense colonies on virtually any type of substratum other than mud.

2) Like most other bivalve mollusks, the mussel is highly fecund. A mature female may release up to ten million eggs at a single spawning.

3) Growth rate is relatively rapid, particularly if off-bottom techniques are utilized. It is estimated that mussels grown in this fashion are marketable in 12 to 18 months. Since the mussel is a filter feeder, subsisting on phytoplankton and particulate organic detritus, its nutritional requirements are immediately available in the water column. Although the meat yeild of wild mussels varies both seasonally and specifically each animal, a bushel of cultured mussels yields about one gallon of wet meats.[19]

4) Due to its habits of attachment, mussels are readily cultured by suspension techniques by which intensive yields can be obtained from relatively small areas. Ryther and Bardrach (1968) report

an annual yield of 240 metric tons of mussels per acre per year in parts of Spain when raft culture techniques are employed.

5) The mussel has been induced to spawn in captivity, and the larve has been reared successfully through metamorphasis (Loosanoff and Davis 1963). However, due to the general abundance of present stock and because annual reproduction appears to occur consistently wherever adult beds are established, artifical techniques for supplying juveniles on a regular basis would probably never be required.

The characteristics of the sea mussel unfavorable for commercial culture in New England are:

1) In the Northeast sector of its range i.e. eastern Maine and the Maritime provinces of Canada, the mussel occasionally becomes toxic and unfit for consumption (Medcof 1947). Incidents of mussel poisoning have been attributed to seasonal blooms of the phytoplanktonic dinoplagellate, Gonyaulax tamerensis, which, when ingested by the mussel, makes the flesh poisonous (Wulford 1958). This is commonly known as 'red tide'. Periods of toxicity appear to be restricted to the late summer and early fall.

2) In certain areas, the mussel may develop pearl, which because of the resulting annoyance when chewed, limit market value. Mussels cultured by suspension techniques are relatively free of this problem.

3) In order to be attractive and presentable for the market, the mussel must be washed and its byssal threads removed. In the past no machinery existed that was specifically designed to shuck mussels; this process was done by hand and constituted a large expense in mussel processing. The byssal threads had to be removed from the

meats after shucking and this increased considerably the time and care required to prepare mussels. Cooked mussel meat could easily be removed from the shell after steaming or boiling.

Recently a company in Nova Scotia, Canada developed the first mechanized technique in North America for processing cultured blue mussels. With technical assistance from the Nova Scotia Department of Fisheries, Lismore Seafoods, Ltd. produced 14,000 cans of blue mussels that were grown on the eastern shore using aquaculture techniques. Without the mechanization Nova Scotia mussels would not have been competitive with European mussels.[20]

Another recent development is that of a machine designed to grade mussels for market. The machine was developed by two researchers in Maine and is designed so that a small business man can assemble it himself. It is reasonably priced.[21]

In 1975 researchers in Maine designed and implemented an innovative system for culturing mussels. It is a modification of the European long-time technique. Two parallel long lines are suspended underwater from a series of plastic floats. The lines are connected by slats placed one foot apart. The mussels are cultured on ropes hanging from the slats. The cost of the entire system is $5,000, and it has the potential of yielding 2,000 bushels of mussels in a year. At the current market price of $20 per bushel, the operation could gross $40, 000 a year. The estimated annual operating costs for the system, including fuel, equipment depreciation, maintenance and other expenses are approximately $5,000 providing a net profit of $35,000 a year.[22] We will now examine the Blue and Gold Sea Farm which utilizes this particular method in the raising of its mussels.

Blue and Gold Sea Farms occupies about five acres of water off an old navy wharf in Middletown called Midway Pier. Blue and Gold was founded in 1978 by C. Graham Hurlburt, a Harvard University administrator who studied mussell farming in Europe. Blue Gold's president, Mr. Link Murray has state permission to eventually expand to sixty acres. In 1979 Blue and Gold Sea Farms harvested 200 bushels while in the 1980-1981 season it is predicted Blue Gold will harvest 30,000 bushels. The 1979 season was experimental. Murray said, "Ultimately Blue and Gold may produce annually between 200,000 and 300,000 bushels--equivilant to the current annual consumption in the U.S." In terms of initial investment Murray has stated, "We've invested $15,000 in every acre out there not counting the mistakes we've made and the marketing tests we've run."[23]

Murray has stated, "Successfully cultivated mussels are superior to the natural variety. We grow them off the bottom so there is no sand in them. They grow faster, so there's no pearl and the shell is clean so they're better for restaurants to serve. Restaurants that have bought from Blue Gold's first marketable harvest have reported sharp increases in orders for the molluscs." Murray also believes that cultivating mussels may be one answer to the chronic problem of bay pollution. Because solid pollutants such as sewage rest largely in bottom sediments, mussels grown from suspended lines may be less subject to contamination.[24]

There are definite signs that aquaculture such as mussel farms is gradually gaining credibility and favor among state officials and other important observers. For one thing, as an industry its future is viewed enthusiastically by investors. Mr. Ronald Smaldone of Hospital Trust Bank said, "We think it has a considerable amount

of potential. There's a demonstrated marketability of the product, and Blue Gold has shown just what young and agressive and bright people can do." Last year Representative Mary M. Kilmarx of Barrington touched off a storm with those citizens of Rhode Island who earn a living as commercial quahoggers when she pressed for approval of legislation simplifying regulation of aquaculture.[25]

Current regulations governing Rhode Island aquaculture as set forth in the state's Coastal Resource Management Program are as follows:

A. 1. Proposed aquaculture activities in Rhode Island's coastal region and/or in any waters subjected to the Council's jurisdiction shall require a Council permit.

2. Applicants for such a permit shall demonstrate by a fair preponderance of evidence that the proposed action will not:
   a. Conflict with any Council management plan or program.
   b. Make any area unsuitable for any uses or activities to which it is allocated by a Council management plan or program; or
   c. Signigicantly damage the environment of the coastal region.

3. Applications shall:
   a. Describe the location and size of the area proposed.
   b. Identify the species to be managed or cultivated within the permitted area and over which the applicant shall have exclusive right.
   c. Describe the method or manner of management or cultivation to be utilized.
   d. Provide such other information as may be necessary to determine
      - The compatibility of the proposal with other existing and potential uses of the affected area and areas contiguous to it.
      - The degree of exclusivity required for aquacultural uses of the proposed site.

4. The Council shall consult with the Department of Environmental Management and the Marine Fisheries Council to ensure that the proposed project is not in conflict with any fisheries management plan, program or regulation.

5. It shall be further demonstrated by reliable and probative evidence that the coastal resources are capable of supporting the proposed activity including the impacts and/or effects upon:

a. The riparian rights of adjacent land owners
b. Navigation
c. Water quality
d. Marine and coastal recreation
e. Native coastal and maine life forms

6. A council permit for a proposed aquacultural activity will be in the form of a lease. Such lease shall contain such conditions as the Council shall deem necessary.

B. Any person who maliciously and willfully destroys, vandalizes or otherwise disrupts aquacultural activities which are the subject of a valid Council permit shall be deemed in violation of an order of the Council and liable to all fines and penalties under law.

C. The Council shall continue to support study and evaluation to identify potential aquaculture sites, use conflicts, and the types of aquaculture programs which are most economically and environmentally consistent with overall Council policy.[26]

Representative Kilmarx's remarks increased quahoggers' fear that a relaxation of existing state laws currently regulating the aquaculture industry could cause history to repeat itself leading to a situation similar to the heyday of the old oyster cultivators. Mr. Dennis W. Nixon has stated, "That's exactly what we're afraid of, a resurgence of the industry that excluded the independent fisherman."[27] Mr. Bill Nolan, a Warren shellfisherman with 38 years experience, is quoted as saying, "I can remember when every piece of land was taken. Any old timer will tell you the same thing. We used to pay 25¢ a bushel just to go fishing in there, when we were only getting $2.00 at the market."[28] Many quahoggers feel that any designation of waters for private commercial fishing is an infringement on their right guaranteed by the stat constitution to a 'free and common fishery' in Narragansett Bay. This tradition dates back to 1639 when a famine was imminent and a general assembly of freemen voted that all water below sea level was declared free for fishing. In the 1683 charter from England

established the Providence Plantation, the right of free fishing was guaranteed to every citizen. The right of free and common fisheries for the public benefit is still jealously guarded by Rhode Islanders. Mr. Nolan voiced the concerns of many Rhode Island shellfishermen when he said, "We don't want to loose even an inch. Once you've started, it's like a cancer."[29]

Presently, the state of Rhode Island does not charge a fee from the existing aquaculture projects even though they have been given exclusive leases to up to 60 acres of Narragansett Bay. Mr. Link Murray has stated that he would be willing to pay a reasonable lease price for his 60 acres. In refering to the 60 acres off Aquidneck Island reserved for Blue and Gold Sea Farms he said,"I'll pay more for an acre of this than anyone else would pay for land that can't be used for shellfishing." The Rhode Island Coastal Resources Management Council will not set a price for leases pending a study by a state commission appointed by Governor Garrahy in September of 1980. Murray said,"Charges in other coastal states in which Blue Gold has an interest range from $5 and $25 an acre." At that scale Blue Gold would pay up to $1500 annually for its 60 acres.[30]

Royalties are another matter. Because they involve a charge on volume of sales or production Murray argues, "Even a small royalty creates and incentive to expand our acreage rather than intensively use the acreage we have," and might lead him to move to leased waters in Oregon or Maine. John Lyons, chairman of CRMC, agreed when he said, "Lease fees are better than royalties. At least they're a fixed expense." Legislation was filed in a General Assembly session in the summer of 1980 that would have charged

aquaculture farms royalties, a provision inserted by quahogging interests. The clause however, was struck from the bill. It was decided instead that a state commission appointed by Governor Garrahy would plan charges for all private commercial uses of the bay including aquaculture farms and marinas as well as resolve fishing conflicts. The state commission consists of twelve members and a chairman representing a variety of area interests such as commercial fishing, aquaculture, sportfishing, an environmental group, the University of Rhode Island, the CRMC, and the state Department of Environmental Management.

Another fear of shellfishermen is that mussel farms like Blue Gold will saturate surrounding waters with larval mussels, which grow in thick blankets over the bottom, bound tightly together with spidery filaments and smothering whatever quahogs may have been buried in the sediment. Robert Rayhill has stated,"They'll be our ruination. Once you get a mussel set they leave their shells and we have to put up with them for eight to ten years. The way those things tie up, they smother everything."[31]

Murray and the state's marine scientific community including William Lappin, a biologist for the state DEM, who oversees aquaculture permits disagrees with Mr. Rayhill. Lappin argues, "Thereare so many natural mussel beds in the bay that when they spawn in the spring, the water is saturated with seed. If conditions are right they'll set. If you add another one tenth of one percent, or two percent, it doesn't affect the setting." Lappin incidently, has come on strongly in support of aquaculture. According to him," Narragansett Bay is a tremendously productive biological system, but a lot of its plankton is just being wasted.

Aquaculture is a way to utilize this productivity in a way compatable with the state's economy. It's nonpolluting and it produces income and food."[32]

Murray agrees that the heavy mussel set indentified by quahoggers in 1980--particularly around Blue Gold's leasehold--is the product of biological cycles. He states, "The fishermen I know never get a heavy set two years in a row, so if there is a heavy set now the facts will rebutt the charges next year."[33]

Aquaculturists and state officials argue that the fears of quahoggers that the aquaculture industry will expand and force them out of the bay as the oyster industry did years ago, is unfounded. They state that the CRMC will not issue an aquaculture permit for any area with an existing quahog bed. They point out that one oyster farming proposal by a Maine fisherman for an area just south of the Jamestown Bridge in fact, was rejected on evidence that quahogs were being fished on the sight. Even this does not allay the fears of most quahoggers, who contend that areas of the bay bottom barren today might be lush with quahogs next year. Robert Rayhill, president of the Rhode Island Quahoggers Association, says,"You can't say where the quahogs are. You never know where a set is going to come in."[34]

Mr. Bruce Rogers, president of the Rhode Island Aquaculture Association, recently accused traditional fishermen of, "mortgaging the future to preserve the past". He claims that aquaculture does not lease large bottom areas as the oyster industry did at the turn of the century, but uses floating gear in relatively small areas to maximize growth rates of shellfish and avoid bottom predators.

His recent remarks criticizing a DEM plan currently undergoing drafting for the CRMC concerning locating sites for aquaculture projects where they will cause the least conflict with other activities has caused even greater anxiety among quahoggers. According to him, each kind of fishing activity should be situated according to its potential for maximizing each area's biological output, not avoiding political problems.[35] The DEM plan would allow aquaculture in roughly half of little Narragansett Bay, Winnapaug Pond, Quonochontaug Pond, Charlestown (Ninegret) Pond, Green Hill Pond and the Pettaquamscutt River.

Dennis W. Nixon, legal council to the Rhode Island Shellfishermans Association, urged Governor Garrahy to appoint the task force. Mr. Nixon has continually stated that members of the Shellfishermans Association believe, "That they are caught between the pincers of pollution from the north of the bay and aquaculture from the south," and that shellfisherman only want to preserve their way of life. I am inclined to support Mr. Nixon's stance in lieu of the earlier portion of this report on Upper Bay water pollution and also in light of Mr. Rogers critical remarks concerning DEM's attempts of siting aquaculture projects in areas where they will not conflict with existing quahog fisheries.[36]

John A. Lyons, chairman and executive director of the state CRMC has stated that aquaculture would not cover the bay, noting that the coastal council has approved only three bay and eleven coastal pond projects since 1978, and is holding off on a fourth bay project west of Prudence Island until Governor Garrahy's task force completes its study. Mr. Nixon agrees that state officials are now careful to reject aquaculture proposals in areas with existing

shellfisheries. "But," he cautioned, "if it (aquaculture) catches on as it gains strength and popularity there will be increasing pressure to approve projects in the bay."[37]

A public hearing on 18 December in Portsmouth resulted in a heated debate between those forces promoting the aquaculture industry and those representing the concerns of the Rhode Island quahogger. The debate concerned an aquaculture permit application by a Mr. William K. Macy to construct a 21 acre commercial mussel farming operation on the west side of Prudence Island. In an effort to win approval for the aquaculture permit, Mr. Macy's legal representative Timothy T. Moore attempted to convince the Coastal Resources Management Council that his proposed project was, in his words, "reasonably compatible with other uses and would not have a significant adverse impact on other uses."[38] He lent particular emphasis on the words 'reasonable' and 'significant' implying that the incidental use of the area by quahoggers, fisherman, lobsterman, and sports fisherman was not in his estimate going to have a "significant or even minimal impact on their livelihood."[39] He also argued that the increased amount of mussel spat caused by a mussel farm would not have a significant adverse impact because "It is really the favorable setting conditions which determine the mussel growth and not the question of how many mussels you have in the bay that are producing spat."[40] This claim of Mr. Moore's has never in fact been substantiated by any type of research or analysis in Narragansett Bay.

Mr. Moore's opponent Mr. Dennis W. Nixon, quoted the preamble from Rhode Island's present aquaculture law which states, "Whereas the process of aquaculture should only be conducted within the

waters of the state in a manner consistent with the best public interest with particular consideration given to the effect of aquaculture on other uses of the free and common fishery, of navigation and the compatibility of aquaculture with the environment of the waters of the state."[41]

Mr. Nixon sought to prove that Mr. Macy's proposed project should be rejected by the CRMC due to failings in three vital areas. The first is that Mr. Macy failed to prove that his aquaculture project is not likely to have an adverse impact on the marine life adjacent to the area he is seeking. Secondly, Mr. Macy failed to prove that the proposed mussel farm would not likely have an adverse impact on the continued vitality of the indigenous fisheries of the state, and third, that the project was consistant with competing uses engaged in the exploitation of marine fisheries.[42]

In his opening remarks, Mr. Nixon successfully showed that an accurate picture of the existing population of fish and shellfish in the proposed site had not in fact been established. Dr. Richard Earl Crawford, a reputed biologist currently employed by the state of Rhode Island, in a study of the abundance and distribution of fish and shellfish in certain Rhode Island waters, stated conclusively that the rocking chair dredge utilized by Mr. William Lappin in predicting the population of quahogs in the site concerned was ineffective as a quantitative sampler of quahogs. Dr. Crawford pointed out that quahog distribution is contagious distribution or clumped distribution vice uniform distribution. He also said that the particular rocking chair dredge utilized in the survey was itself defective in that four of the eighteen teeth were broken. Furthermore, the teeth were spaced 1½" apart and it also had 2" rings in the back which would be biased toward only the larger

shellfish rather than getting a cross sampling of the existing population as was intended.

Dr. Crawford also refuted the accuracy of a similar report by Dr. Oviatt which utilized a Van Veen dredge or grab sampler on the basis that Dr. Oviatt only sampled ten stations of one square meter a piece and reported a .9 quahog density. The fact of the matter is that the area in question consists of 85,000 square meters so Dr. Oviatt's sampling was about one hundredth of one percent of the entire area. Dr. Crawford stated that he had in fact, sampled a few places and had identical results. He states that a .9 density can be very misleading. He said, "I have had densities of .9 quahogs per square meter and there have been commercial fisheries in the same water and in order for me to adequately sample these areas I have had to go to fishermen and in a separate type of survey ask for directions, if you will, for where the quahogs are and them sample those areas separately."[43] Dr. Crawford also pointed out that a recent report from the Department of Natural Resources concerning shellfish populations in areas very near the site in question have densities of 1 to 4.1 and are actively shellfished.

Finally, Dr. Crawford took issue with Dr. Oviatt's report that the characteristics of the bottom sediment of the site in question are 'a soft bottom community and it is quite unnatural that quahogs, which prefer a sandier sediment, could ever be abundant in such an area.' Dr. Crawford stated that the exact nature of the bottom sediments in the area of concern has never been clearly established. One report by a Dr. M^{c}Master, describes the bottom characteristic as being clayey silt consisting of less

than 29 percent sand; another report by a geologist stated that the bottom had a content of greater than 50 percent sand.

Dr. Crawford also made comparison of this site and the Ohio Ledge in Narragansett Bay. Ohio Ledge, one of the largest shellfishing areas today, has a bottom composed of clayey silt similar to that of the area in question. Twelve years ago the Ohio Ledge went through a period of dormancy whereas today it is a very productive area. This in itself is solid evidence that a clayey silt bottom can in fact support a tremendous number of quahogs.

Mr. Nixon then addressed the environmental impact of mussel farming. Dr. Crawford stated, "I do believe a large, dense population of any robust shellfish, or fecund shellfish, is going to affect the immediate area particularly where the environment is so favorable. Hope Island and Despair Island are both good habitat, and I think we could expect to see mussels appearing inareas where they haven't been, and anybody that has had a dock or a mooring line could expect increased fouling such as occurs when a lobsterman gets his gear near a natural mussel bed."[44]

In questioning Mr. John Smith, a commercial fisherman and lobsterman from the state of Maine, who testified on behalf of Mr. Macy, Mr. Nixon asked,"Have you had the occasion of having a little trouble with mussels on your lobster gear wher they in fact coat your pots, cover the line just as the same polypropylene that they will utilize to attract mussels and spat in the proposed aquaculture site?" Mr. Smith responded that 'that the only time I have had that problem is when I have lost a trap for about six months and I haven't been tending it. The line goes back out over the stern and most of that stuff is glided off. If you haven't been

tending your gear maybe six months it will be fouled, but if you are tending it---". Mr. Nixon then interjected that this only goes to prove that the marine environment of Maine with its cold waters is far different than that of Rhode Island which is characterized by warmer waters and faster rates of mussel production.[45]

Mr. Paul Hoxsie a commercial Rhode Island fisherman was asked, "In the question of mussels and lobstering, could you tell the members of the council if in fact there is any problem with mussels accumulating on pots and lines in Rhode Island waters?" Mr. Hoxsie responded, "In the past two years we have had a problem with mussels coating the pots just like barnacles or seaweed to the stage where after three or four weeks you'll have to bring the lobster pots in and dry them out and brush them off with a wire brush because there are so many massels on them you can't get them off with rakes. This is also on the lines."[46]

Mr. Nixon then verified the fact that the waters of the proposed site are in fact utilized by commercial shellfishermen through the testimony of Mr. Robert Rayhill. Mr. Nixon specifically asked, "Would the members of the Rhode Island Shellfishermans Association be adversely affected if these 21 acres were taken away from them?" Mr. Rayhill responded, "Yes I really think they would be, the simple reason we are having so much trouble with pollution with the Upper Bay being closed, and not only that we have over 3000 quahog licenses out and we haven't got enough room now for the 3000."[47]

Mr. Nixon the asked Mr. George Levesque, a representative of the Rhode Island Inshore Fishermans Association if the granting of an aquaculture permit would adversely effect his group's interests.

Mr. Levesque replied,"Yes, this is pretty much right in the area of another tow. We just lost ground to the MERL project. We had our troubles with that and it took a big chunk of our ground. Now this guy is going to take some more of our ground. We're running out of places to fish up there."[48] Mr. Levesque also stated that the proposed mussel farm would prevent him from safely maneuvering his inshore dragger in the area. He estimated that he would need 200 yards to ensure safe maneuverability taking into account wind and currents in the bay.

The fact that the site in question is utilized by commercial lobstermen was verified by Mr. Hoxsie of the Rhode Island Lobstermans Association when he said, "Presently there are five lobsterman from Wickford, as well as sveral from Warren, Bristol, and Newport lobstering on and about the locus of this application. This is a traditional winter lobster ground and is used during other seasons as well. The area has been known to b a good producing bottom in the past. These men's commercial well being is at stake."[49]

Mr. Jacob Dyastra, president of the Point Judith Fishermans Cooperative Association, objected to the use of the sight for aquaculture in that 'This is one more loss of trawlable ground. we are loosing trawlable ground all the time to various activities.' He also stated that the need existed for a complete environmental impact statement on the issue, before any type of sound responsible judgement could be made.[50] Mr. Daniel Dickinson, owner and operator of a small inshore dragger,testified that he utilized the area in question as wellas approximately nine other small time operators.

Mr. Ralph Boragine Spokesman of the New England Fishing Steering Committee stated that, " The steering committee has in

the past and would most likely in the future support aquaculture wherever it can, and it has done this in several ways in the past. However, the reason we are making a stand tonight and not supporting this one is because it conflicts with the ongoing fisheries."[51]

Mr. Fred M^cCaron , a Rhode Island commercial shellfisherman, recently circulated a petition against the granting of a license on the proposed site. His petition, which consisted of 1,783 signitures represented a cross section of the citizens of the state, is an indication that the general public is also apposed to the proposal.

Mr. Sydney Greenwall, president of the Narragansett Bay Yachting Association stated that there are overnight mooring areas in the proposed site and that yachts do sail past that area on their way to other mooring sites south of Pine Hill which are frequently used. The proposed site is also used as an area of transit for all kinds of official sailing events. When asked by Mr. Nixon if the members of the NBYA would be adversely impacted if the proposed aquaculture farm was allowed to be built, Mr. Greenwall responded, "I would say that anything that restricts sailing in the waters would be of serious concern to us. I'm not familiar with the impact extnet of the aquaculture floats, how far out they would be, but, from what I have seen, it would certainly be of some concern."[52]

Mr. M^cFarland, a Portsmouth resident, stated, " What I am concerned about is the fact that everyone here, most everyone here are fisherman, but many people are actually concerned with visual pollution which is a question that has to be considered."[53] Mr. Macy's proposed aquaculture farm would place 3,500 five foot plastic

buoys in the bay.

Mr. Harold Cutty, of North Kingston, pointed out that Mr. Macy's mussel farm will employ somewhere in the order of about 30 people during peak employment with maybe a dozen full time and the remainder seasonal as the harvest season goes on. He stated, "The council would kindly note, I think represented here this evening are probably over 350 to 400 members of different associations connected with the Lobster Association, Fishermans Association, and Shellfishermans Association and I think they also represent their families and I would hope, and I know you will certainly take this into consideration, that the employment of not only the older people, the old timers in the fishing industry, but also the many younger people who are attracted to fishing and quahogging being independent fisherman themselves." Plain and simple Mr. Macy's proposed mussel farm will eliminate more jobs than it will create.

I wholeheartedly agree with Mr. Nixon's final analysis of the situation when he addressed the CRMC with the statement, "I just want to conclude by saying that your role tonight is to take a look at the aquaculture law passed by the General Assembly last year to determine if the applicant met certain statutory burdens, not one, not two, certainly not three.

He will have negative economic, social, and environmental effects for the people of the State of Rhode Island. It will benefit only Mr. William Macy. This in our opinion is exactly the type of proposal that the new aquaculture law was designed to prevent. Whenever there is a significant impact on an existing fishery of any kind, and we've got half a dozen here, tonight, it is your role to deny that application because so many other people are going to be adversely affected. This is a long-term lease we're talking about. We're talking about a long-term danger

to the state's fishing industry. We ask you to reject this proposal and reject it strongly."[54]

Finding and Recommendations

1) I do not agree with Mr. William Lappin's statement "The biological aspects of aquaclutrue are pretty much known."[55] More research is needed concerning the allegation that increased mussel spawning from mussel farming has resulted in saturating the surrounding waters with larval mussels, which grow in thick blankets over the bottom and smother whatever quahogs may have settled in the sediment. Further information is also needed concerning an accurate means of sampling and estimating quahog population. There are strong indications that neither the rocking chair or the Van Veen dredge is properly suited to the species concerned due to its clumped distribution. Additional information is also needed on the characteristics of the ocean floor necessary to support quahogs.
2) Despite the protests of many quahoggers who feel that any designation of any Rhode Island waters for private commercial fishing is an infringement on their right guaranteed by the state constitution to a 'free and common fishery' in Narragansett Bay, today aquaculture is firmly entrenched in Narragansett Bay and will remain so well into the foreseeable future. The grim realities of the Rhode Island quahoggers precarious situation dictate that the state of Rhode Island adhere to strict permitting and licensing procedures in the issuing of aquaculture licenses in Narragansett Bay. Aquacluture has its place in the state's economy but certainly not at the expense of those Rhode Island citizens who rely on quahogging, lobstering, and fishing for a living. I believe that Mr. Dennis Nixon's closing remarks in the CRMC's hearing concerning Mr. Macy's aquaculture permit most aptly describes the situation.

Mr. Nixon said, "We don't have a lot of economic strengths in the state of Rhode Island, but our commercial fishing industry is one of them. When you imagine the potential harmful impact that this project could have against an existing strong industry, it would be very shortsighted to approve a venture like this.

Mr. Moore also suggested we are universally opposed to aquaculture. No one has said we are universally opposed to aquaculture. We are opposed wherever it conflicts with an existing commercial fishery, and in Narragansett Bay that happens to be a good percentage of the bay.

Now, in the State of Maine, where they have four thousand miles of coastline as opposed to four hundred miles, we don't think they have as big a problem. We do in this state. We are concerned. We don't like men like Mr. Macy to make a buck because every small fisherman here is a businessman who makes a dollar. You have got hundreds of people out there making a living now that will be hampered in their ability to make a buck if you let this happen in the bay where he has proposed to do it.

Finally, when you look at what is required under the aquaculture law, he hasn't met the burden. The evidence that has been presented simply hasn't met the burden under the law."[56]

So long as the members of the CRMC and concerned Rhode Island citizens demand that a tight adherence and proper interpretation of Rhode Island's aquaculture laws continue to be observed, the interests and rights of the independent Rhode Island quahogger will be properly safeguarded. Thus, Mr. Lappin's prediction, "That the aquaculture business in Rhode Island will ultimately run up against natural confines. It is going to be limited because the coastal

waters of the state are already so heavily used. There will be probably a few more small operations, but Blue Gold mussel farm will remain unique." will become a reality. [57]

FIGURE 1

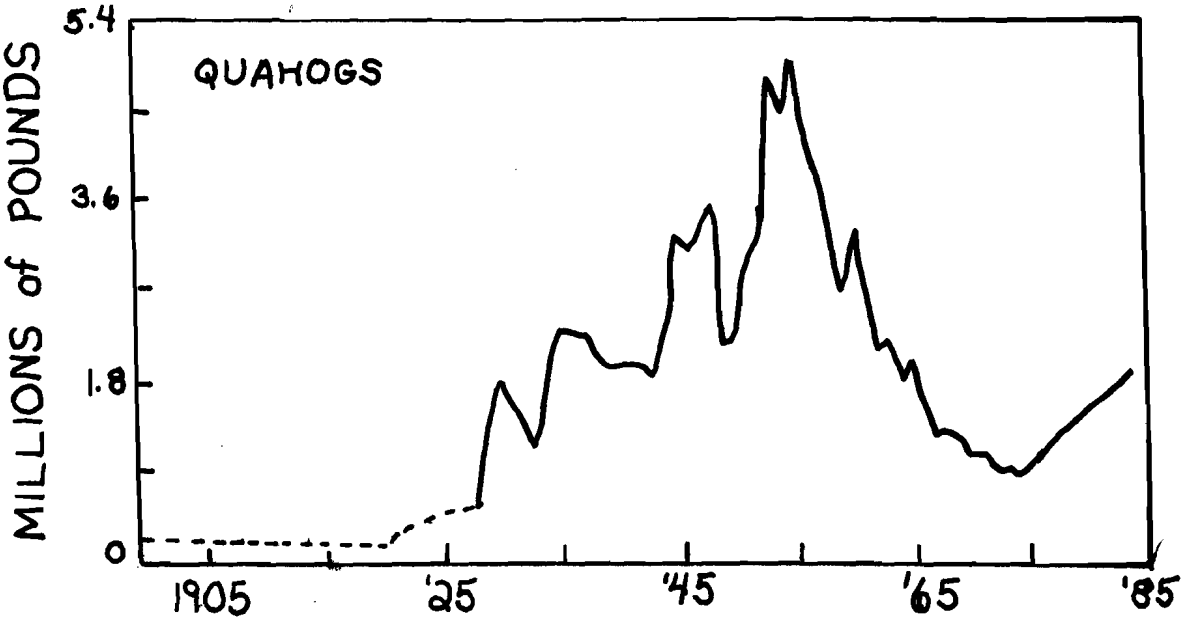


FIGURE 2

License Category				
	Cost	Number/Revenue 1979 Licenses	Number/Revenue 1980 Licenses	% Increase
Over 65 (Shoredigger)	$1.00	115/$115	127/$127	10%
Over 65 (Boat)	$2.00	158/$316	200/$400	27%
Student (Shoredigger)	$5.00	108/$540	181/$905	68%
Student (Boat)	$6.00	378/$2,268	555/$3,330	47%
Under 65 (Shoredigger)	$15.00	179/$2,685	289/$4,335	61%
Under 65 (Boat)	$16.00	1597/$25,264	2110/$33,760	34%
Replacement	$1.00	51/$51	81/$81	59%

FIGURE 3

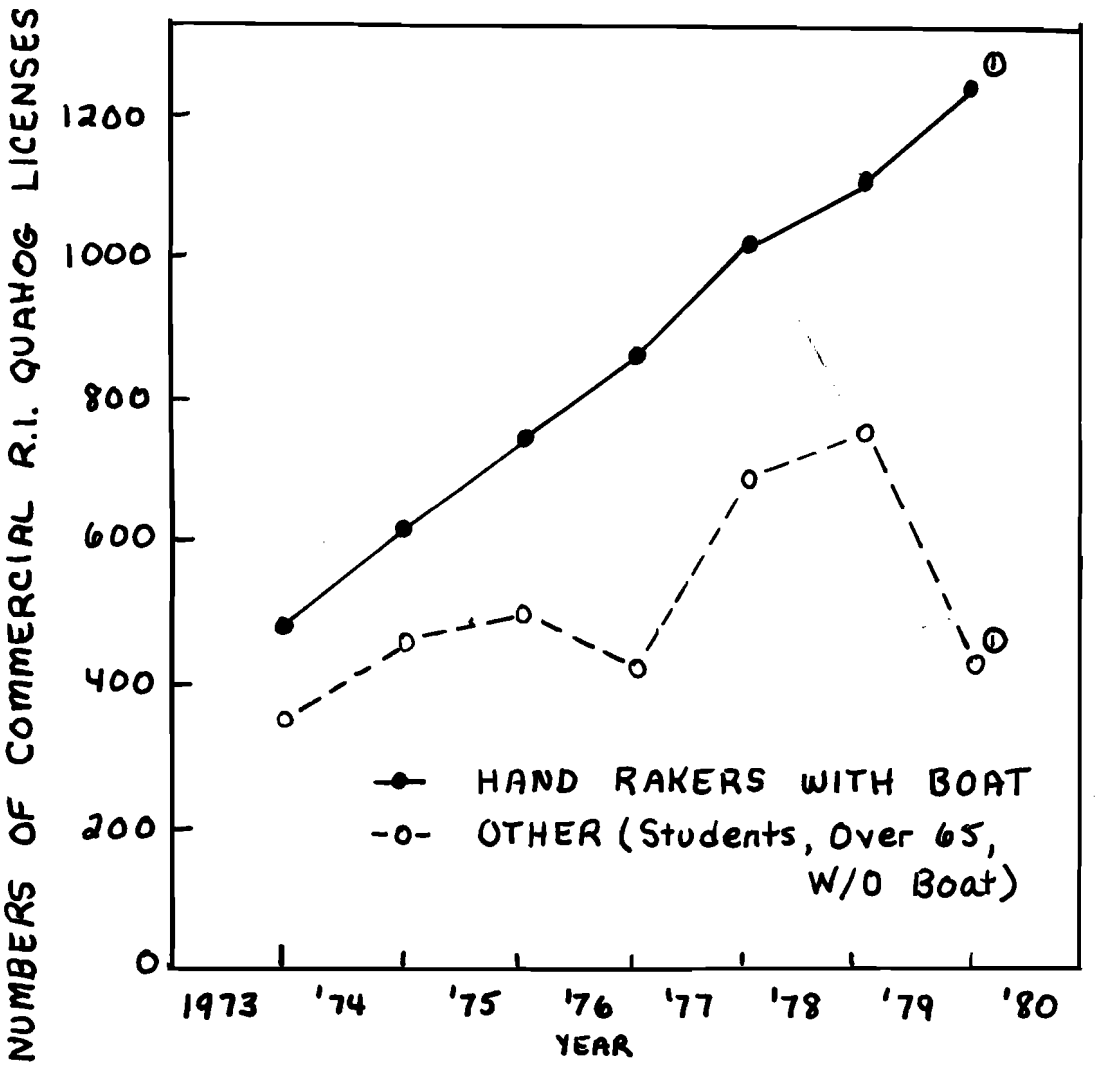
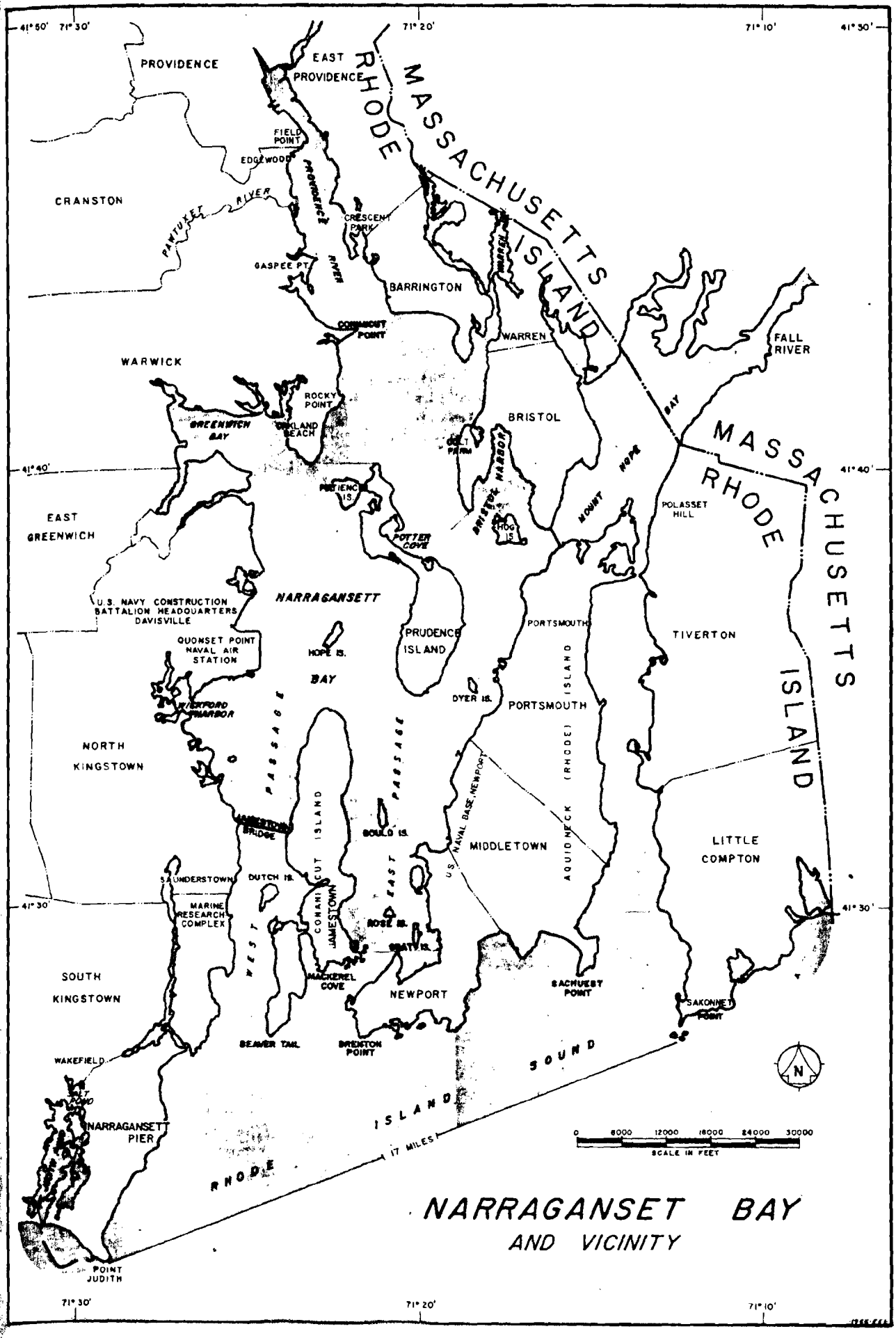

NUMBERS OF COMMERCIAL R.I. QUAHOG LICENSES
1200
1000
800
600
400
200
0
1973
'74
'75
'76
'77
'78
'79
'80
YEAR
HAND RAKERS WITH BOAT
OTHER (Students, Over 65, W/O Boat)

FIGURE 4



NARRAGANSET BAY
AND VICINITY

FIGURE 5

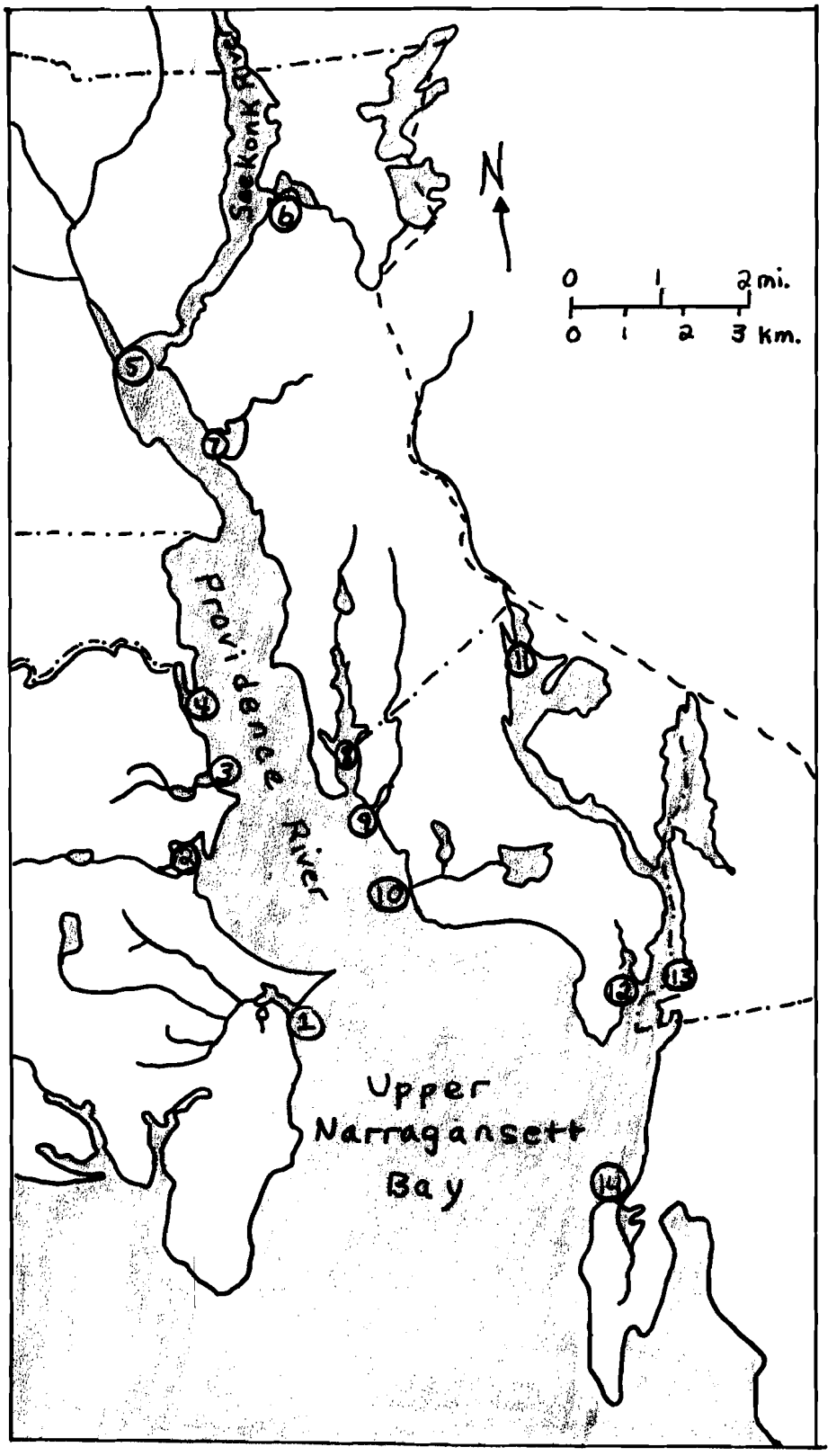
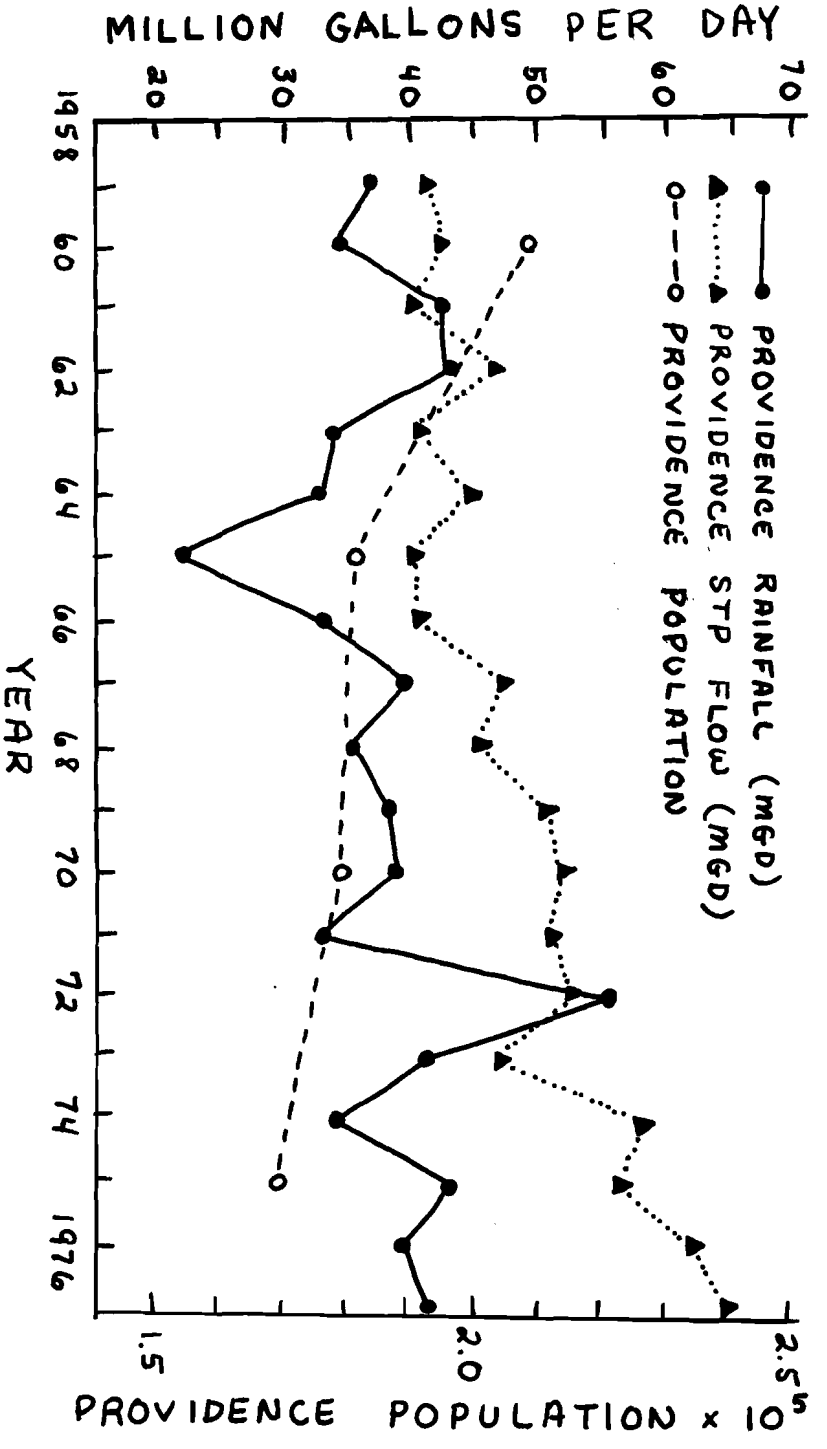

Seekonk River
Providence River
Upper
Narragansett
Bay
N
0 1 2 mi.
0 1 2 3 km.
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

FIGURE 6

Major Tributaries and Basins of the Upper Narragansett Bay

1) Buckeye Brook/Mill Cove
2) Spring Green Pond/Occupessatuxet Cove
3) Unnamed Brook/Passeonquis Cove
4) Pawtuxet River/Pawtuxet Cove
5) Woonasquatucket, West, & Moshassuck Rivers/Providence River
6) Ten Mile River/Omega Pond
7) UnnamedBrook/Watchemoket Cove
8) Willett Pond/Bullock Cove
9) Annowomscutt Brook/Drown Cove
10) Brickyard Pond, Echo Lake/Mussachuck Creek
11) Runnins River/Barrington River
12) Unnamed Brook/Smith Cove
13) Barrington and Palmer Rivers/Warren River
14) Unnamed Brook/Mill Gut

FIGURE 7


MILLION GALLONS PER DAY
20
30
40
50
60
70
1958
60
62
64
66
68
70
72
74
1976
YEAR
PROVIDENCE RAINFALL (MGD)
PROVIDENCE STP FLOW (MGD)
PROVIDENCE POPULATION
1.5
2.0
2.5
PROVIDENCE POPULATION x 10^5

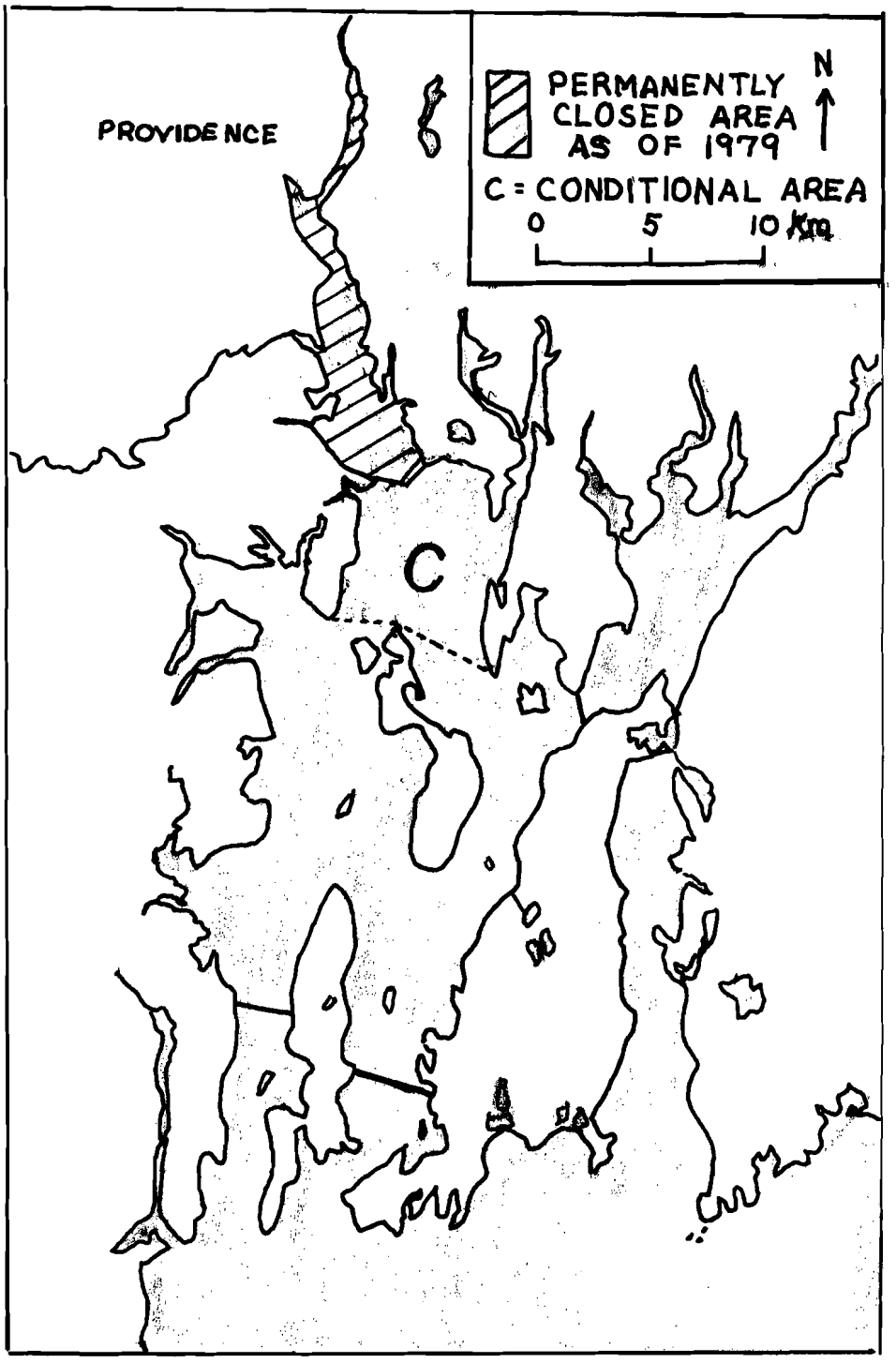

PROVIDENCE
PERMANENTLY CLOSED AREA AS OF 1979
N
C = CONDITIONAL AREA
0 5 10 Km
C

FIGURE 9

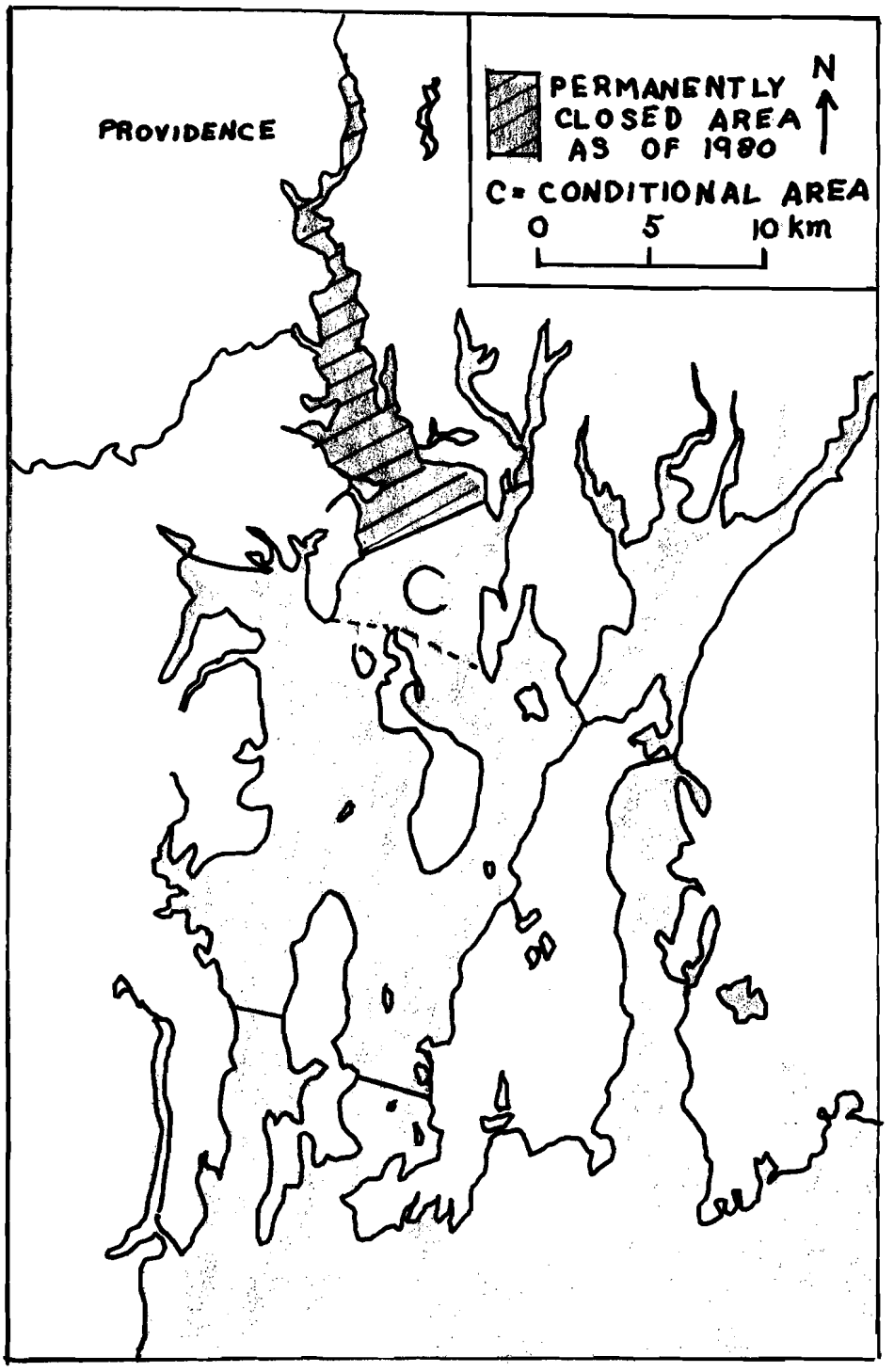

PROVIDENCE
PERMANENTLY CLOSED AREA AS OF 1980
N
C= CONDITIONAL AREA
0 5 10 km
C

FIGURE 10

UPPER NARRAGANSETT BAY CONDITIONALLY APPROVED

SHELLFISHING AREA CLOSURE SUMMARY 1969-1978

Year	No. of Days Closed	% Closed	Annual Precipitation
1969 (Mar 26-Dec 31)	61	22*	44.59
1970	59	16*	45.42
1971	100	27*	38.42
1972	263	72	65.06**
1973	246	67	48.24
1974	180	49	40.66
1975	201	55	50.83
1976	183	50	46.32
1977	260	71	48.84
1978	271	74***	47.01

* Different procedure used to determine closure: 3/4" rain

** Record precipitation

*** Record Closure Time

FIGURE 11

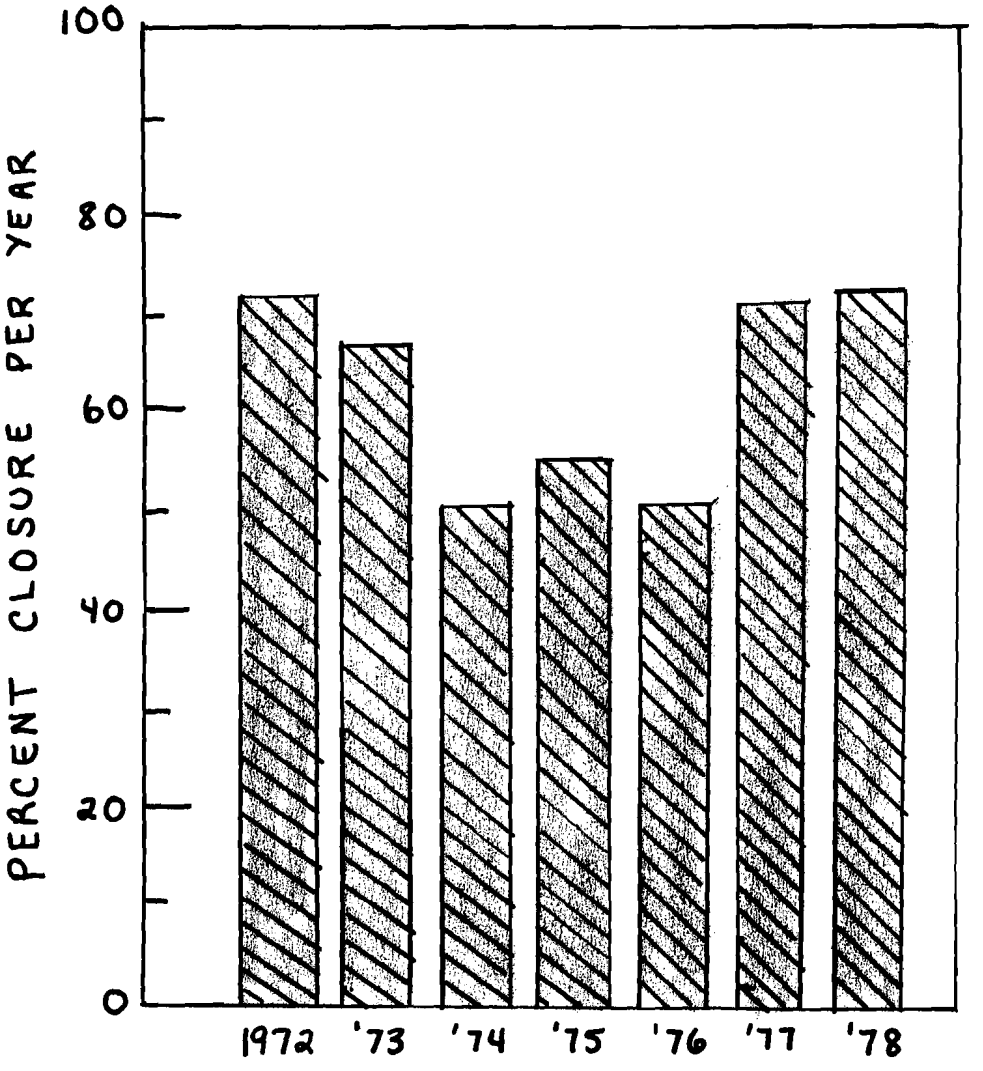


Figure 12

Existing and Proposed Publicly Owned

Wastewater Treatment Facilities

EXISTING (Level of treatment)

1. BVDC (secondary)
2. Bristol (primary)
3. Cranston (secondary)
4. East Greenwich (secondary/tertiary)
5. East Providence (secondary)
6. Narragansett-Scarbourough (primary)
7. Newport (primary)
8. Providence (secondary)(not operating at secondary)
9. South Kingston-Narragansett(secondary)
10. Warren (primary)
11. Warwick (secondary)
12. Westerly (primary)
13. West Warwick (secondary)
14. Woonsocket (secondary)
15. New Shoreham (advanced using microstrainers)
19. Quonset (existing primary plant to be abandoned, new secondary facility planned at different location Quonset)

UNDER CONSTRUCTION (Level of treatment)

12. Westerly (upgrade to secondary)
16. Smithfield (advanced using microstrainers)
17. Burrillville (secondary and phosphorus removal)
18. Jamestown (secondary)

PLANNED (Level of treatment)

2. Bristol (upgrade to secondary)
3. Cranston (upgrade to advanced with nitrate removal)
6. Narragansett-Scarbourough (upgrade to secondary)
7. Newport (upgrade to secondary)
10. Warren(upgrade to secondary)
19. Quonset-North Kingstown (secondary)

FIGURE 13

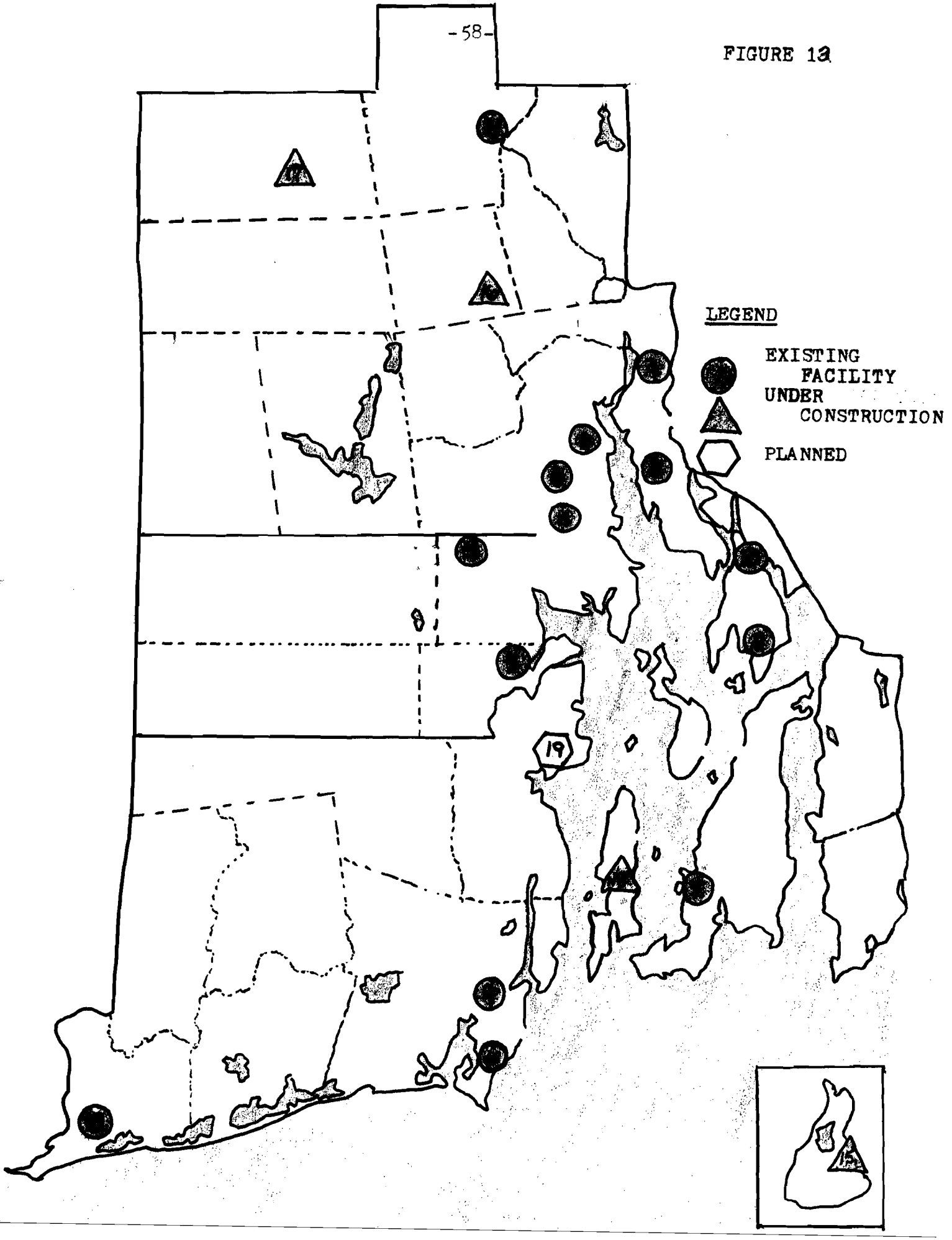


FIGURE 14

Key Number	Sewage Treatment Plant
1	BVDC
2	Providence
3	Narragansett Village
4	Warwick
5	Cranston
6	West Warwick
7	East Greenwich
8	South Kingstown
9	Jamestown
10	Jamestown
11	Newport
12	Bristol
13	Fall River
14	Warren
15	East Providence

FIGURE 15

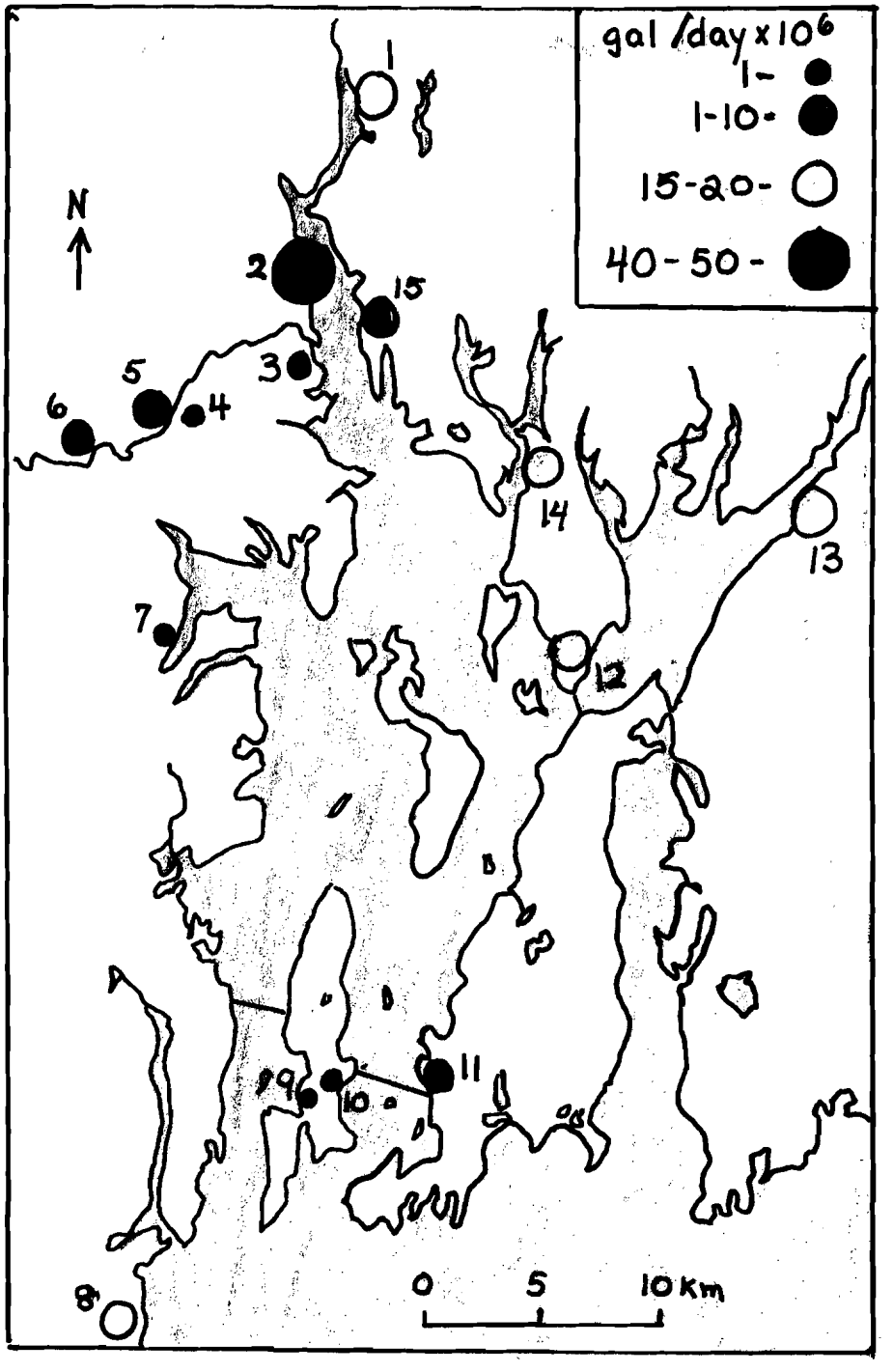

gal/day x 10⁶
1-
1-10-
15-20-
40-50-
N
1
2
15
3
5
4
6
14
13
7
12
11
9
10
8
0
5
10 km

FIGURE 16

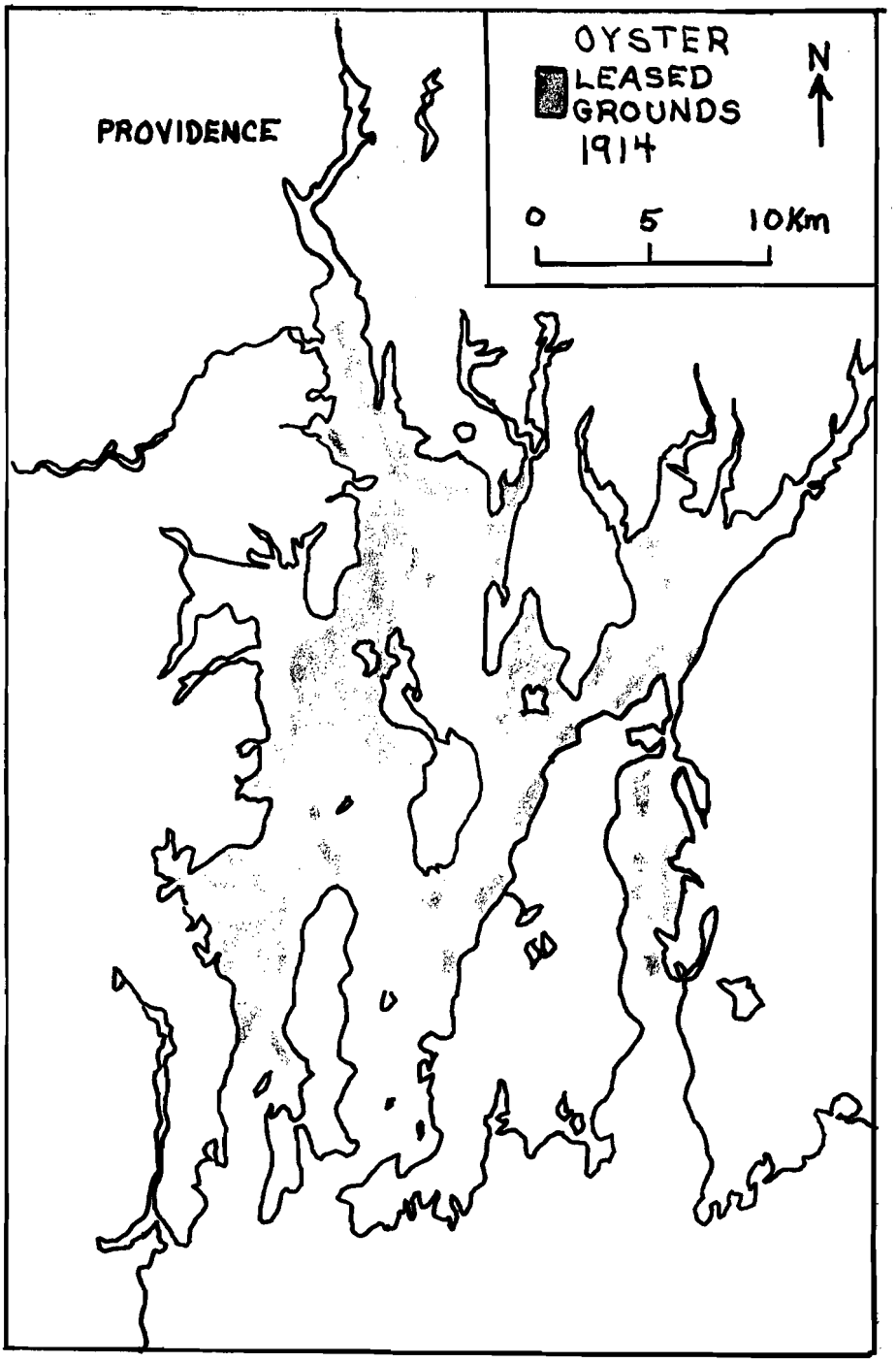
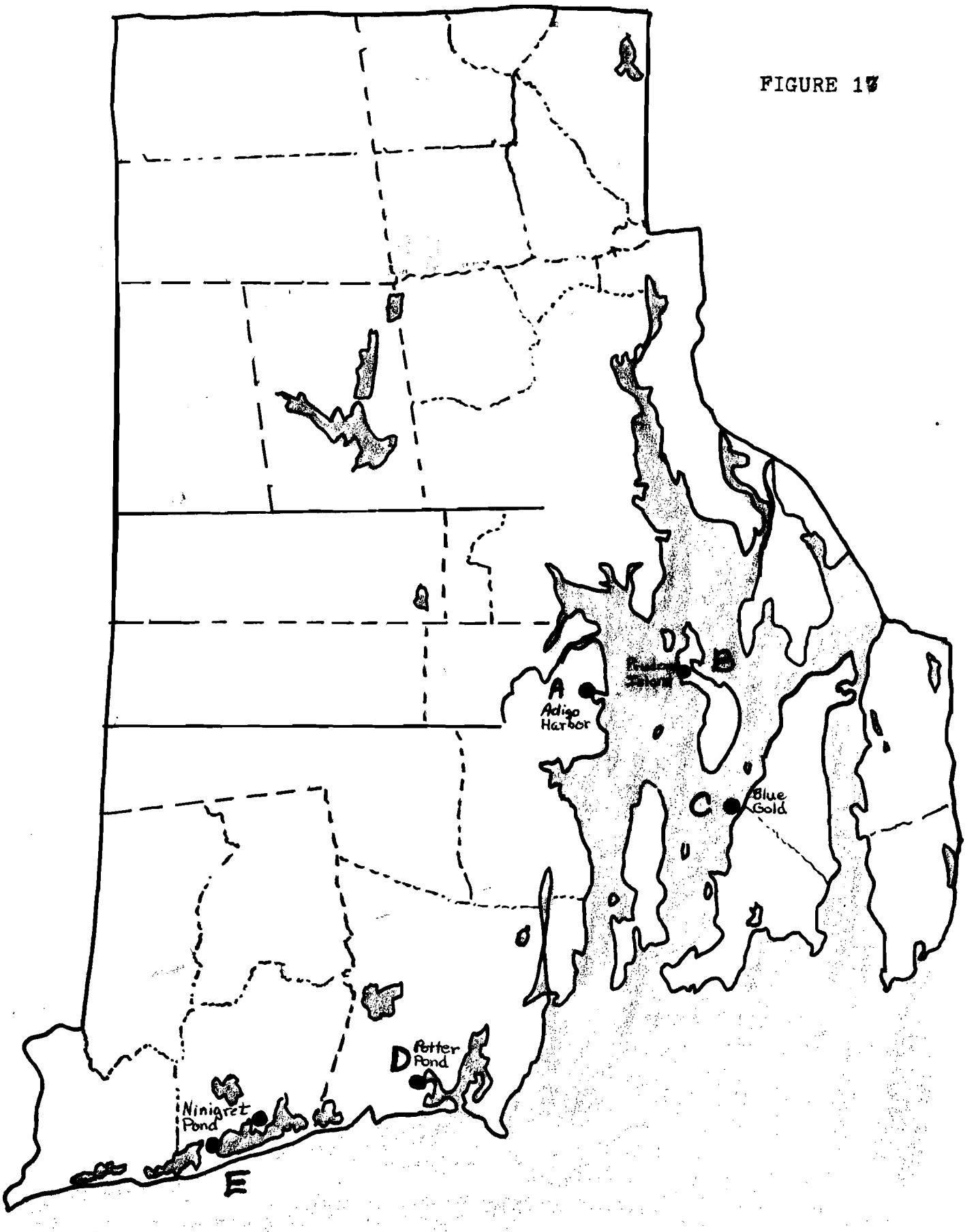


FIGURE 17



FOOTNOTES

[1]Donald D. Robadue Jr. and Virginia Lee, Preliminary Report on the Upper Narragansett Bay, An Urban Estuary In Transition. (University of Rhode Island: Coastal Resources Center, 1980), p. 16.

[2]Ibid., p. 16

[3]Ibid., p. 19

[4]U.S., Department of Commerce, National Oceanic and Atmospheric Administration Office of Coastal Zone Management, State of Rhode Island Coastal Management Program and Final Environmental Impact Statement. (Washington, D.C.: U.S. Government Printing Office, 1978), p. 111.

[5]Donald D. Robadue Jr. and Virginia Lee, Preliminary Report on the Upper Narragansett Bay, An Urban Estuary In Transition. (University of Rhode Island: Coastal Resources Center, 1980), p. 21.

[6]Ibid., p. 19

[7]Ibid., p. 21

[8]Ibid., p. 21

[9]Michael A. Hiltzik, "Courts Get Tough Against Quahoggers," Providence Sunday Journal, 15 June, 1980, sec. B, p. B2.

[10]Ibid., p. B2

[11]Ibid., p. B2

[12]Ibid., p. B2

[13]Donald D. Robadue Jr. and Virginia Lee, Preliminary Report on the Upper Narragansett Bay, An Urban Estuary In Transition. (University of Rhode Island: Coastal Resources Center, 1980), p. 135.

[14]Ibid., p. 136

[15]Ibid., p. 11

[16]Ibid., p. 12

[17]Thomas A. Gaucher, ed., Aquaculture: A New England Perspective, (New England Marine Resources Information Program, 1970), p. 30.

[18]Robert Rosenberry, ed. Aquaculture Digest, vol. 4 (San Diego: USPS, August 1979), p. 28.

[19]Robert Rosenberry, ed. Aquaculture Digest, vol. 4 (San Diego: USPS, August 1979), p. 25.

[20]Robert Rosenberry, ed. Aquaculture Digest, vol. 4 (San Diego: USPS, July 1979), p. 23.

[21]Ibid., p. 22

[22]Robert Rosenberry, ed. Aquaculture Digest, vol. 4 (San Diego: USPS, June 1979), p. 24.

[23]Michael A. Hiltzik, "Aquaculture vs. The Quahogger," Providence Sunday Journal, 8 June, 1980, sec B, p. B7.

[24]Ibid., p. B7

[25]Ibid., p. B7

[26]U.S., Department of Commerce, National Oceanic and Atmospheric Administration Office of Coastal Zone Management, State of Rhode Island Coastal Management Program and Final Enironmental Impact Statement. (Wahington, D.C.: U.S. Government Printing Office, 1978), pp. 70-71.

[27]Michael A. Hiltzik, "Aquaculture vs. The Quahogger," Providence Sunday Journal, 8 June, 1980, sec B, p. B7.

[28]Ibid., p. B2.

[29]Ibid., pp. B2, B7.

[30]Ibid., p. B7.

[31]Ibid., p. B7.

[32]Ibid., p. B2.

[33]Ibid., p. B7.

[34]Ibid., p. B2.

[35]Robert C. Frederiksen, "Competing Interests State Positions at 1st Fishing Meeting," Providence Journal, 24 February 1981, sec A, p. A10.

[36]Ibid.

[37]Michael A. Hiltzik, "Aquaculture vs. The Quahogger," Providence Sunday Journal, 8 June, 1980, sec B, p. B2.

[38]State of Rhode Island and Providence Plantation Coastal Resources Management Council Subcommittee Hearing In Re: William K. Macy, Application of., File No. 80-6-19, 18 December 1980, p. 100.

[39]Ibid.

[40]Ibid., p. 102.

[41]Ibid., pp. 4-5.

[42]Ibid., p. 5.

[43]Ibid., p. 17.

[44]Ibid., p. 28.

[45]Ibid., p. 82.

[46]Ibid., pp. 88-89.

[47]Ibid., pp. 31-32.

[48]Ibid., pp. 34-35.

[49]Ibid., pp. 36-37.

[50]Ibid., pp. 42-43.

[51]Ibid., pp. 47-48.

[52]Ibid., p. 55.

[53]Ibid., p. 92.

[54]Ibid., p. 52.

[55]Michael A. Hiltzik, "Aquaculture vs. The Quahogger," Providence Sunday Journal, 8 June, 1980, sec B, p. B7.

[56]State of Rhode Island and Providence Plantation Coastal Resources Management Council Subcommittee Hearing In Re: William K. Macy, Application of, File No. 80-6-19, 18 December 1980, pp. 104-105.

[57]Michael A Hiltzik, "Aquaculture vs. The Quahogger," Providence Sunday Journal, 8 June, 1980, sec B, p. B7.

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"Competing Interests State Positions at First Fishing Meeting." Providence Journal, 24 February 1981, sec. A, p. A10.

"Courts Get Tough Against Quahoggers." Providence Sunday Journal, 15 June 1980, sec. B, pp. B1, B2.

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Island Coastal Management Program and Draft Environmental Impact Statement. Washinton, D.C.: U.S. Government Printing Office, 1977.

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