Massachusetts Marine Fisheries

ASSESSMENT AT MID-DECADE

Economic, environmental and management problems facing Massachusetts' commercial and recreational marine fisheries

November 1985

Commonwealth of Massachusetts
Division of Marine Fisheries
Department of Fisheries, Wildlife
& Environmental Law Enforcement
Executive Office of Environmental Affairs

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The Commonwealth of Massachusetts

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November 19, 1985

Dear Friend:

On behalf of the Department of Fisheries, Wildlife, and Environmental Law Enforcement we are pleased to send you a copy of the recently released report, "Massachusetts Marine Fisheries - Assessment at Mid-Decade" prepared by the Division of Marine Fisheries with help from the Office of Coastal Zone Management and Department of Environmental Quality Engineering.

This report is a statement of concern intended to: 1) increase public and legislative awareness of the problems confronting our fisheries, and 2) accelerate existing efforts and lead to new attempts to meet the Commonwealth's commitment to a safe and well-balanced environment and sound resource base. The report is also intended to serve as a discussion document to be used at upcoming January public hearings sponsored by the Marine Fisheries Advisory Commission.

The Division of Marine Fisheries is furthering its efforts to reverse the trend of continuing adverse impacts on the Commonwealth's marine resources. Your input as a legislator, scientist, public official or concerned citizen is essential if we are to succeed. Therefore, please take the time to review this report and plan to attend and offer your comments and concerns at one of the public hearings listed below.

Tuesday	January 7	Whaling Museum Auditorium New Bedford	7:00-10 pm
Thursday	January 9	Marshfield Town Hall	7:00-10 pm
Thursday	January 16	Cape Cod Community College Science Building, Hall A, Barnstable	7:00-10 pm
Wednesday	January 22	Gloucester City Hall	7:00-10 pm
Wednesday	January 29	Gardner Auditorium State House, Boston	10 am-4 pm

Only through a collective effort can we hope to maintain the preeminent position the Commonwealth enjoys as a result of a healthy coastal environment and abundant marine resources.

For further information contact Philip Coates or David Pierce at 727-3193.

Sincerely,

Walter E. Bickford
Commissioner

Philip G. Coates
Director

WEB/PGC:elk

ACKNOWLEDGMENTS

This paper was written by the Division of Marine Fisheries with assistance from the Office of Coastal Zone Management. David Pierce of DMF was the editor and a contributor. Other DMF contributors were: Michael Hickey, Elizabeth Amaral, Andrew Kolek, and Philips Brady. Patricia Hughes of CZM was a contributor and coordinated CZM's input and review. DMF reviewers were James Fair, Sherry Sass, Leigh Bridges, and Randall Fairbanks. Anthony Rodriguez of the Department's staff also reviewed the paper. Steven Lipman coordinated the Department of Environmental Quality Engineering input and review.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Massachusetts Division of Marine Fisheries (DMF) is responsible for protecting and enhancing the Commonwealth's living marine resources. It is charged with promoting and developing Massachusetts' commercial and recreational fisheries and with implementing management strategies developed in concert with the Marine Fisheries Advisory Commission. These responsibilities led to the preparation of a 1982 Marine Fisheries Policy Report which was designed to "coordinate agencies and programs to assure long-term stability of the fishing industry as well as wise management of the living marine resources". The Report, adopted by the Governor, defined the Division's advocacy of the Commonwealth's fisheries. This White Paper is a result of the role. It is a statement of concern intended to: 1) increase public and legislative awareness of the problems confronting our fisheries, and 2) accelerate existing efforts and lead to new attempts to meet the Commonwealth's commitment to a safe and well-balanced environment and a sound economic resource base.

Massachusetts' fishing industries are faced with a myriad of problems which must be addressed. These are pollution and associated fish and shellfish contamination, excessive fishing, and habitat loss and degradation. Other impediments to fisheries are inadequate port facilities, inadequate public access, Canadian competition for U.S. markets, the new U.S./Canada boundary partitioning Georges Bank between the two countries, and escalating insurance costs for fishing vessels. Other factors contributing to the decreased vitality of the Commonwealth's marine fisheries are related to regulatory, management, and research programs; for example, inadequate funding and staffing, policy conflicts, lack of interagency coordination, and conflicting goals.—fisherman strikes!

Some of these problems are obvious and already have received media and public attention. Unfortunately, this attention generally has been short-lived and piecemeal. Considered too complex or costly to address, problems and their underlying causes either have been accepted or forgotten. More subtle problems have gone unnoticed. Perhaps this is because each individual pollutant source, incidence of fish and shellfish contamination, habitat alteration, or occurrence of excessive fishing seems relatively inconsequential. Isolated events frequently are treated as natural and unavoidable consequences of a growing state economy and coastal development.

This attitude should not continue. If it does, the Commonwealth risks losing its fight to preserve its natural heritage and the integrity of its marine resources and environment. Efforts of state agencies already seeking to preserve and rebuild marine resources and to protect the environment needed for sustenance of fisheries resources require the continued and increased support of the public and the Legislature.

Commercial and recreational marine fisheries are of great economic value to the Commonwealth. Increased efforts should be made for their continued protection and enhancement. Based on the value of commercial landings, adjusted by economic multipliers, a very conservative estimate of the worth of Massachusetts' commercial fisheries to the state's economy in 1984 was $1 billion. Much of this value was due to landings of eight species - sea scallops, cod, lobsters, yellowtail flounder, haddock, winter flounder, bluefin tuna, and swordfish. These species were responsible for 78% of the value of landings in 1984. Lobster is the state's most valuable inshore fishery. In 1983, lobster caught in Massachusetts territorial waters were valued at approximately $21,118,000. Value of all inshore shellfisheries, including such species as soft-shell clams, bay scallops, and quahogs, was approximately $24 million in 1983.

In 1982, approximately 870,000 saltwater anglers fished Massachusetts waters. This compares with approximately 6,300 state licensed commercial fishermen in 1984 (DMF records). Generally, the most important finfish caught (in terms of numbers) by recreational fishermen are winter flounder, pollock, bluefish, cod, and mackerel in that order. Striped bass is also important and has a special mystique. Additionally, in 1984 over 38,000 family permits were issued by cities and towns for shellfish such as soft-shell clams, quahogs, and bay scallops, and 11,158 permits were issued to recreational lobster fishermen by DMF.

In contrast to commercial fisheries, the value of recreational fisheries is difficult to determine since there are no accurate records of total catch, number of fishermen, or economic impact on the Commonwealth's economy. Nevertheless, a 1980 estimate (excluding shellfish) of approximately $111.6 million has been calculated.

To be sure, there are many users of the Commonwealth's marine living resources. Anything adversely affecting these resources similarly impacts these users and even non-users who value clean water, a safe and healthy environment, and enjoyable outdoor recreational opportunities.

Commercial and recreational marine fisheries are impacted directly or indirectly by pollution of near shore waters such as harbors and estuaries. Pollution may render fish and shellfish unfit to eat in some areas or may impact their health by causing disease. Pollution can and does create an unwarranted public perception that all seafood is unsafe and unfit for consumption. A few major examples include:

--- A high prevalence (8%) of liver cancer has been documented in Boston Harbor winter flounder. The Harbor has the highest reported prevalence on the east coast. Additional DMF sampling in Boston Harbor this winter revealed a prevalence

of 42%. The pathology of these lesions is not yet known, but it is suspected that they include precancerous and cancerous lesions. Cancerous liver tumors also have been found in Salem Harbor winter flounder. The extent and effect of liver cancer on the winter flounder resource are uncertain as is the potential effect on human health.

--- A relatively high prevalence of fin rot has been noted for winter flounder in Boston Harbor. The prevalence has been as high as 44%. This disease, characterized by eroded and damaged fins, is believed to be triggered by pollutant stress. Heavy metals, PCB's, petroleum residues, and fecal coliform bacteria all appear to contribute to the problem. Flounder live in close association with the bottom where wastes accumulate.

--- Two types of lobster disease associated with a high level of pollution have been found in Massachusetts Bay and Buzzards Bay. Percentage shell disease (shell erosion and tissue destruction) was highest near the Acushnet River and New Bedford Harbor (33% and 50%, respectively, of fish examined). Percentage black gill disease (gill erosion and tissue destruction) was highest in these areas (about 52%) and off Boston Harbor (33%).

--- PCB levels in lobster and finfish from the Acushnet River estuary are higher than State Public Health and Food and Drug Administration tolerance levels. Several areas of the estuary are closed to all or some fishing activities. Recent sampling of lobsters from areas thought by DMF to show prospects for a future opening indicate that PCB levels have increased unexpectedly.

--- Sediment contamination presents a major problem for much-needed dredging projects. Dredging, as well as disposal of dredged material, raises serious environmental concerns such as the potential for release of sediment contaminants (e.g., PCB's) to the water column and benthic animals at dredging and disposal sites.

--- Public fear of consuming fish with contaminant levels above standards can and has led to a common fear that all fish are unsafe. This unwarranted belief impacts markets for fish which are free of contaminants. It puts a stigma on seafood.

--- In the last two years there has been a 28% increase in the amount of closed area to shellfish harvesting on the South Shore and Southeastern Massachusetts due to bacterial contamination. Presently, about 25,400 acres (40 square miles) are closed. On Cape Cod, acreage has been closed in 14 new areas, and six closed areas have been expanded for a total of 2,100 acres - 300% and 200% increases over acreage closed in 1980 and 1982, respectively. Additionally, in 1984 a significant number of acres in formerly pristine areas such as the Westport River (630 acres) and the North and South Rivers (2,400 acres) were closed.

--- On the North Shore and in Boston Harbor a total of 6,781 acres (11 square miles) are closed or restricted to harvest. Much of this acreage (4,690 acres) is in Boston Harbor; consequently, waters adjacent to Boston, Milton, Quincy, Hull, Braintree, Weymouth, Hingham, and Winthrop are closed or restricted. On the North Shore approximately 60% of productive shellfish areas are closed or restricted for shellfishing.

--- Bacterial contamination causes an estimated total annual loss of $12.1 million in landed value to Massachusetts shellfisheries. If reasonable economic multipliers are applied, the total loss is about $55-$79 million.

--- Pesticide use by the cranberry industry is increasing especially in Southeastern Massachusetts. Commonly used pesticides in the cranberry industry are highly toxic to fish, shellfish, crabs, and shrimp. Since most major watersheds in Buzzards Bay and on Cape Cod drain large areas of cranberry bogs, there is cause for concern that pesticides might pose a threat to shellfish resources in these areas by causing immediate mortality or affecting reproductive success. do

--- The exact magnitude of the acid rain problem confronting species of diadromous fish (fish that move between fresh and saltwater) such as river herring is unknown. However, the potential for major impacts on reproduction, survival, and growth of these fish is great. Acid rain has been implicated as a major contributing factor to the decline of striped bass and might be impacting the Commonwealth's river herring, smelt, and other species.

In addition to pollution, habitat loss and degradation is a problem for the Commonwealth's fisheries. Coastal areas provide spawning, nursery, and feeding areas for our important finfish and shellfish; therefore, as habitat disappears or is degraded, fish and shellfish populations and fisheries dependent on these resources decline.

This loss is occurring because: 1) Conservation Commissions and proponents of coastal alteration projects frequently misunderstand existing regulatory standards and/or lack the expertise and staff to properly assess projects' potential effects on wetland areas; 2) careful state reviews of all Conservation Commissions' orders of conditions for approved projects are not always possible; 3) there is a need for a greater state commitment to the Wetlands Restriction Program. Specifically, of about 90,000 acres of salt marsh and tidal flats in Massachusetts, only about one-third have permanent deed restrictions regulating dredging, filling, removing or otherwise altering coastal

CZM - Educate Workshops

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wetlands; 4) shellfish surveys leading to Wetlands Protection Act prohibitions against permanent alterations or destruction of habitat cannot be routinely performed; and 5) a recent resurgence of recreational boating has resulted in more private docks and requests for alterations and expansions to existing docks with associated dredging and habitat loss.

Another significant problem is excessive fishing caused by too many fishermen and fishing vessels with high fishing power all competing for their "share" of finite inshore and offshore resources. Excessive fishing is also caused by ineffective fisheries management strategies due to inadequate planning and insufficient law enforcement. Excessive fishing has led to significantly reduced resource abundance, smaller and less fish and shellfish being landed in our ports, and economic hardship for the state's fishing industry. Some examples are:

--- Abundance of Georges Bank haddock, an important component of Massachusetts fishermen's catch, has declined 75% between 1980 and 1983. Haddock reproduction from 1979 to the present has declined to the point where prospects for the immediate future look bleak. Landings reflect this reduced abundance. Total 1984 Georges Bank U.S. landings declined 30% from 1982 and 50% from 1980.

--- Sea scallops, the species responsible for New Bedford's 1984 ranking as the number one port in the nation (value of landings), have declined in abundance on Georges Bank. U.S. catch per effort was 22% lower in 1984 than in 1983 (43% lower than 1982) and was the lowest observed from 1965-1984. Landings from the most productive portions of Georges Bank were down 34% and 53% from 1982 and 1983, respectively.

--- Winter flounder has shown a constant downward trend in abundance. Since 1975, large market category winter flounder has declined steadily, and the percentage of small and "pee wee" fish in landings has increased. This trend is indicative of a resource problem.

--- The Division of Marine Fisheries resources surveys of coastal waters showed drastic declines from 1983 to 1984 in abundance of juveniles and adults of many species important to commercial and recreational fisheries. The 1984 fall survey preliminary results were cause for alarm. For example, winter flounder declined about 48% from 1983 and a previous six-year average; young fish (pre-recruits) decreased 59% from 1983. Young scup, butterfish, black sea bass, and long fin squid decreased 35%, 71%, 49%, and 70%, respectively. Prospects for the future are not encouraging.

--- Fisheries observations and landings of fish caught in Massachusetts waters support DMF survey results. Many Massachusetts inshore fishermen indicate a lack of marine fish resource in state waters (and elsewhere) and continue to express concern for the future. National Marine Service statistics of percent decrease in landings of fish caught from Massachusetts waters showed the following constant downward trends: cod down 54% since 1978; winter flounder down 46% since 1978 and yellowtail flounder down 61% since 1979.

--- In 1982, 10,300 metric tons of yellowtail flounder were landed from southern New England waters. An additional 3,300 metric tons were discarded because fish were too small. If these fish were allowed to reach a larger size before harvest, a minimum of about $10 million potentially could have been realized at the producer level.

--- A lack of resource, especially in offshore waters, is apparently prompting larger, very powerful vessels to shift their operations inshore. This shift in effort is worsening the resource picture for inshore waters and the economic plight of fishermen with smaller vessels more dependent on inshore grounds.

Other negative impacts on the commercial fishing industry are inadequate port facilities, Canadian competition for U.S. markets, the newly set U.S./Canada boundary partitioning Georges Bank, and escalating fishing vessel insurance.

--- Minimal requirements such as safe berthing, ample space to off-load fish, and adequate access do not exist in many Massachusetts ports. For example, in Boston the fishing industry is losing its struggle to maintain or rehabilitate facilities due to competition with real estate interests, other waterfront development, and/or politics. In Hyannis, recreational boats compete directly with fishing vessels for moorings and berths.

--- Over the past four to five years Canadian imports have reached unparalleled proportions. For example, during the first half of 1984 imports of fresh cod fillets approached the total volume of 1982 (7.9 million pounds). The Canadian fishing industry is now attempting to make major inroads into the Commonwealth's fresh fish markets. In contrast to the U.S. fishing industry, the Canadian industry is heavily supported by the Canadian government.

--- The new U.S./Canada boundary is denying Massachusetts fishermen access to productive fishing grounds and is causing fishermen to fish farther inshore thereby worsening the status of the Commonwealth's inshore fisheries, increasing competition with smaller vessels fishing on these resources, and increasing user group conflicts. According to the Northeast Fisheries Center of the National Marine Fisheries Service,

13%, 33%, 12%, and 15% of cod, haddock, yellowtail flounder, and sea scallops, respectively, caught by U.S. fishermen on Georges Bank in 1983 were taken east of the boundary.

--- The difficulty of securing insurance for fishing vessels has been increasing in recent years. Because of sinkings and large cash settlements received by injured fishermen, companies are either refusing to issue insurance or are significantly increasing premiums. Consequently, fishermen are forced to remain at the dock, pay the high premiums, or fish without insurance.

An additional impact on recreational fishing, besides reduced abundance of sport fish, is inadequate public access. Many recreational fishing sites accessible only a few years ago are now unavailable due to the fencing off of areas and closing of piers. This diminished access is due, in large part, to coastal development. The problem is coastwide. As an example, on the south side of Cape Cod, no trespassing signs stretch from Woods Hole to Chatham.

Finally, this Paper underscores problems related to regulatory, management, and research programs. It stresses the fact that Massachusetts has a fairly sound legal and regulatory framework for addressing environmental issues. But, in order to fully utilize it and keep pace with the increasing impacts on marine resources, several problems must be addressed: adequate budgets and staffing must be provided, new policies developed and other policy conflicts resolved, research and monitoring efforts enhanced and coordinated, and general cooperation among all parties must be improved.

--- More work is need to identify and abate non-point pollution sources along our coastal areas. There is a need for additional technical and financial assistance at the local and regional levels to accomplish these tasks.

--- There is insufficient staffing, lack of specific federal standards for many toxics, and extraordinary reporting difficulties leading to deficiencies in the state's present industry compliance monitoring system and the state's knowledge of the sources, total volume, and composition of waste released into coastal waters.

--- Situations arise where salt ponds with unstable inlets begin to close and tidal exchange is reduced or ended. Many of these ponds have, or could have, significant shellfish and finfish populations if their openings to the sea where seasonally maintained. However, because of the regulations governing barrier beaches and dunes, it is difficult to get permission to maintain tidal exchange into such ponds.

--- While shellfish habitat is afforded protection under the coastal regulations of the Wetland Protection Act (WPA), prohibitions on permanent alterations or destruction of this habitat can occur only if it is mapped by DMF. Unfortunately, the mapping of shellfish habitat cannot be routinely performed due to lack of funds and staff.

--- A dispersion of responsibilities between agencies for regulation and management of contaminated shellfish and their habitat has created serious problems in communication and coordination and considerable confusion for communities and fishermen. The entire issue of shellfish contamination needs to be closely examined, and workable solutions to the problems must be implemented.

--- Public agencies which are mandated to both protect natural resources as well as promote public access and waterfront development can act in contradictory ways. Often, this inconsistency in actions is attributable to a failure to adequately consider alternatives which reduce or eliminate impacts on coastal wetlands areas.

--- Implementation of the Wetland Protection Act is primarily a municipal responsibility. Appeals of local decisions are resolved by the regional offices of DEQE. This decentralized administrative organization offers numerous advantages but also can result in inconsistent decision-making. Improved policy guidelines and training for decision-makers are needed to reduce these difference.

--- Illegal alterations of wetlands remains a serious problem, as well. Improved coordination between local, state, and federal agencies is required if habitat protection programs are to be strengthened. In addition, existing law enforcement personnel in EOEA agencies should be utilized to more actively protect a broader range of environmental interest.

--- There are several deficiencies in the shellfish reimbursement program for coastal cities and towns. Funding for the reimbursement program has remained at the 1974 level, so local programs, expanded in response to state funding, have been slowly eroded as salaries, etc., increased. The expansion of local shellfish programs has greatly increased the need for technical assistance at the state level, and placed additional administrative burdens on DMF. The need for technical assistance and administration of reimbursements cannot be met adequately by DMF under existing personnel and budget constraints. In addition, the greatly increased interest in private shellfish aquaculture over the last decade and the resulting need for technical assistance, surveys, and licensing at the state and local levels has further worsened the problems created by level funding.

--- Investigations to identify the existance and extent of problems in the Commonwealth's marine environment, identification of trends through monitoring, and major efforts to develop remedies or means to curtail this pollution have been minimal. Fortunately this situation is changing. More of these types of programs have been developed or proposed. The key need now is for continued and new support for these initiatives.

W120 enforcement. Also study in tropics!

Efforts to address problems confronting Massachusetts fisheries, the resources on which they depend, and the environment vital for the maintenance of these resources must be accelerated and not allowed to abate. The major concern is that these problems are responsible for or eventually will result in great economic losses to the Commonwealth; e.g., areas closed to shellfish harvest due to bacterial contamination causes an estimated annual economic loss of $55-$79 million.

It is now up to the public, the Legislature, and state agencies, charged to protect the public's best long-term interests to reverse the course of our continued adverse impact on Massachusetts commercial and recreational marine fisheries, the resources on which they depend, and their habitats.

Solution will not come easily. Regarding concerns related to pollution, many of the problems and issues confronting fisheries and environmental agencies are complex, multifaceted, and require interdisciplinary approaches to resolution. Many problems are long-standing and chronic in nature and have developed over many decades. There are few "quick fix" solutions to these chronic problems. For example, many of the environmental sciences, engineering practices, and waste treatment technologies are still evolving and developing in the area of toxics control, dredge spoil disposal, and combined sewer overflow control. Many solutions to problems are not yet within reach. Furthermore, some of the known and proposed solutions (for example, dredging New Bedford Harbor to remove PCB's) are oftentimes complex, sometimes economically infeasible, and frought with uncertainties.

Nevertheless, much can be done and is being done already. A spurring on of agencies is needed to accelerate their existing efforts and to develop new initiatives to meet the Commonwealth's commitment to a safe and well-balanced environment and a sound economic resources base. Public and legislative support is critical.

INTRODUCTION

The Massachusetts Division of Marine Fisheries (DMF) is responsible for protecting and enhancing the Commonwealth's living marine resources. It is charged with promoting and developing Massachusetts' commercial and recreational fisheries and with implementing management strategies developed in concert with the Marine Fisheries Advisory Commission. These responsibilities led to the preparation of a 1982 Massachusetts Marine Fisheries Management Policy Report[1] which was designed to "coordinate agencies and programs to assure long-term stability of the fishing industry as well as wise management of the living marine resources". The Report, adopted by the Governor, defined the Division's advocacy of the Commonwealth's fisheries. This White Paper is a result of that role. It is a statement of concern intended to: 1) increase public and legislative awareness of the problems confronting our fisheries; and, 2) accelerate existing efforts and lead to new attempts to meet the Commonwealth's commitment to a safe and well-balanced environment and a sound economic resource base.

Massachusetts' valuable marine resources, their habitats and commercial and recreational fishing industries, that these resources support are important components of the Commonwealth's economic viability, historic character, and prestige. Promotional materials recently developed to attract business and tourists to Massachusetts emphasize the values placed on our fisheries and marine resources. For example, the brochure, "Come Share The Spirit of Massachusetts", highlights the Commonwealth's fishing ports, coastal parks and wildlife areas, the length and beauty of our varied coastline with its exceptional beaches, and productive coastal waters. The importance of these links to the sea and the economic and recreational opportunities they present are key elements of Massachusetts' national appeal.

Massachusetts' fishing industries are faced with a myriad of problems which must be addressed. These include pollution and associated fish and shellfish contamination, excessive fishing, and habitat loss and degradation. Other impediments to fisheries are inadequate port facilities, inadequate public access, Canadian competition for U.S. markets, the new U.S./Canada boundary partitioning Georges Bank between the two countries, and escalating insurance costs for fishing vessels. Other factors contributing to the decreased vitality of the Commonwealth's marine fisheries are related to regulatory, management, and research programs; for example, inadequate funding, policy conflicts, and lack of interagency coordination.

Some of these problems are obvious and have already received media and public attention. Unfortunately, this attention generally has been short-lived and piecemeal. Considered too complex or costly to address, problems and their underlying causes either have been accepted or forgotten. More subtle problems have gone unnoticed. Perhaps this is because each

individual pollutant source, incidence of fish and shellfish contamination, habitat alteration, or occurrence of excessive fishing seems relatively inconsequential. Isolated events frequently are treated as natural and unavoidable consequences of a growing state economy and coastal development.

This attitude should not continue. If it does, the Commonwealth risks losing its fight to preserve its natural heritage and the integrity of its marine resources and environment. Efforts of state agencies already seeking to preserve and rebuild marine resources and to protect the environment needed for sustenance of fisheries resources require the continued and increased support of the public and the Legislature.

There are many existing and proposed programs or activities which already demonstrate a state commitment to address many of the problems facing our fisheries. For example, the recently created Water Resources Authority offers hope that the health of Boston Harbor can be considerably improved. The Division of Water Pollution Control has an ambitious five-year (1986-1990) strategy related to such things as wastewater and septage projects and an inventory, classification, and reduction of major toxic problems in the state, to name a few. The Division of Marine Fisheries is developing a comprehensive inshore fisheries management plan to rebuild depleted inshore fish populations and to address other management concerns. The Coastal Zone Management Program is administering an $11 million state bond program for the rehabilitation and/or construction of public coastal facilities such as wharves, piers, and for purchase of coastal properties. While these state agencies and other entities with plans for the betterment of marine living resources and their environment have good intentions, these best of plans might fall short of their objectives without public and legislative support. It is hoped that this Paper will lead to a sharing of our concerns, more support, and an acceleration of efforts to address the problems described herein.

CZM CFP

FISHERIES

Commercial Fisheries

Massachusetts' fishing industry has an impressive standing in the nation. In 1984 Massachusetts was third nationwide in value ($233.5 million) and sixth in total volume (375.5 million pounds) of landings[2]. In New England the Commonwealth ranked first in both categories with 54% of the value and 54% of the volume. This does not adequately describe the total value of fisheries to our state, however, because landed product must pass through a series of production and distribution steps before being marketed. Landed value of Massachusetts' total catch must be multiplied at least four times to adequately reflect the fishing industry's actual contribution to the Commonwealth's economy. Consequently, a very conservative estimate of worth would be approximately $1 billion in 1984.

About 46 species of edible fish, shellfish, and crustaceans are landed by Massachusetts fishermen in over 50 ports (Fig. 1). The species of greatest value are sea scallops, cod, lobster, yellowtail flounder, haddock, winter flounder, bluefin tuna, and swordfish. These eight species were responsible for about 78% of 1984 commercial landings in Massachusetts.

The diversity of our state's fishing industry is reflected by its variety of ports, harbors, and types of fishing vessels. Ports range from New Bedford and Gloucester - the Commonwealth's largest commercial fishing ports with the greatest number of vessels - to the smaller ports typified by Provincetown and Chatham.

New Bedford traditionally has ranked among the nation's top fishing ports. In 1984 it was the nation's number one port in terms of value of landings ($107.7 million), more than $23 million above its nearest competitor. In 1984 there were approximately 193 vessels (draggers and scallopers) from 60-130 feet landing yellowtail flounder, sea scallops, cod, haddock, winter flounder, and other species. This port's fishermen usually make trips of 7-10 days at sea and often fish over 100 miles offshore.

Gloucester leads all Massachusetts ports in volume of fish landed. Nationwide, in 1984 it ranked seventh (ninth in value at $37.1 million). Many Gloucester fishing vessels concentrate on lesser-valued fish such as whiting, ocean perch, sea herring, and menhaden. Cod, haddock, and flounder also contribute substantially to this port's landings. Additionally, Gloucester is New England's largest frozen fish processing port utilizing imported fish almost exclusively.

Boston, once New England's and the country's premier fresh fish center especially famous for haddock, is now homeport to a relatively small number of vessels. In 1984, 20.2 million

pounds with a value of $11.2 million were landed in Boston. Boston is known primarily as New England's center for the distribution and processing of fresh and frozen imports.

In addition to these three large ports, Provincetown, Chatham, Sandwich, Plymouth, Scituate, Westport, Harwich, Woods Hole, and many other smaller ports rely heavily on "fish dollars" generated by their local fishing industries. These ports primarily support day-boat fisheries on inshore fishing grounds, generally within 12 miles of the coast. Vessels participating in these fisheries are usually less than 60 feet and include a large fleet of vessels which fish exclusively for lobster. In 1983 Massachusetts' lobstermen landed 12,136,600 pounds worth approximately $29,613,000; 71% of this value was attributed to territorial water's catch making lobster the state's most valuable inshore fishery. Value in 1984 increased to $31,996,800.

Moreover, in virtually every Massachusetts coastal town there are numerous skiff fishermen who seasonally shift gear and fisheries. These fishermen, like their counterparts using larger vessels, are opportunists subject to the vagaries of fish abundance and competition.

Finfish, lobster, and sea scallops are not the only commercial fisheries in our state. The inshore shellfishery is a major component of Massachusetts marine fisheries and an integral part of our coastal heritage. Important inshore species of commercial value are soft-shell clams, quahogs, oysters, bay scallops, surf clams, blue mussels, and to a lesser extent, razor clams and two species of conchs. In addition to sea scallops, important offshore shellfish include surf clams, ocean quahogs, and Icelandic scallops.

Shellfisheries provide employment for more than 4,000 commercial fishermen[3]. In 1983, 28.5 million pounds of shellfish valued at over $105 million were landed. Inshore shellfisheries accounted for $24 million or 22.9% of the total landed value. The value of shellfisheries to the Commonwealth in 1983 was approximately $500 million (economic multiplier of 4.5).

Recreational Fisheries

Saltwater sportfishing is a major recreational activity in Massachusetts. Abundance of fish and numerous angler services attract sportfishermen to the Commonwealth's shores. Marine sportfishing provides food and recreation to the angler and contributes substantially to our state's economy. In 1980, the most recent year for which data are available, 556,000 saltwater anglers spent about $111.6 million in pursuit of their sport in Massachusetts[4]. In 1982, there were an estimated 870,000 anglers.

Recreational fishing for species such as striped bass, winter flounder, bluefish, and scup can be divided into shore fishing and

boat fishing. Shore fishing includes fishing from beaches, banks, jetties, piers, docks, and bridges. Boat fishing can be categorized as private boat, party boat, and charter boat. There are 170,000 boats registered in Massachusetts, and based on estimates from earlier studies, 26% or 44,200 are used for saltwater angling[5]. This estimate probably should be higher due to a population shift toward coastal towns. While statewide population increased only 1% from 1970-1980, population in coastal areas, especially southeastern Massachusetts and Cape Cod, increased 20%.

In 1984 approximately 56 party boats operated out of 24 ports along the Massachusetts coast. A party boat is a sportfishing boat open to all fishermen who are charged a flat rate per person. Passenger capacities range from 20-80 fishermen. Most vessels make trips daily during summer and on weekends only in the spring and fall. Boats averaged 92 fishing days in 1975 and carried an average of 26 passengers per trip[6]. Assuming these averages are still valid, in 1984 about 134,000 fishermen fished from party boats. At an average cost per trip of $18, total 1984 fares were approximately $2,411,000.

A charter boat is a sportfishing boat hired for a trip by a group of six or fewer people. There were 127 charter boats fishing out of 33 ports in 1973[6]. Average cost per trip in 1973 was $270. If, in 1984, charter boats averaged 68 fishing trips (1975 estimate) a total of approximately $2,332,000 was spent on charter fares.

The above estimates are conservative since recreational fisheries are difficult to survey and their statistics are incomplete and imprecise, particularly since saltwater anglers currently are not licensed in Massachusetts. There is no precise way to adequately assess the number of recreational fishermen in this state.

Another major component of the marine sportfishing industry is the bait and tackle shop. The 1983 Massachusetts Saltwater Fishing Guide lists 84 bait and tackle shops in our coastal cities and towns. This total, however, does not include numerous inland shops or department and discount stores which in recent years have been major suppliers of tackle. In 1980 marine anglers in Massachusetts spent about $27.6 million for saltwater fishing equipment[4].

Other costs included in the $111.6 million spent on saltwater fishing in Massachusetts in 1980 were $58 million for food, lodging, and transportation. Fishing obviously contributes to the tourist trade and benefits hotels and restaurants.

Not included in the total value are cost of new boats and boat fuel. In 1975 saltwater anglers in Massachusetts spent approximately $9 million for new boats, motors, and trailers. Party and charter boat sales were $3.6 million. Boat fuel expenses were $2.6 million[7]. Adjusting for inflation over the past

nine years (34% since 1975) and assuming level purchasing, 1984 expenses would have been $20.4 million.

Recreational fisheries also exist for shellfish and lobster. There are 38,000 family shellfish permit holders in the Commonwealth[3]. In 1984 11,518 non-commercial licenses for lobster fishing were issued by DMF.

ENVIRONMENT

The Commonwealth's nickname, "the Bay State", underscores the importance of Massachusetts' coastal habitats. These coastal environments provide spawning, nursery, and feeding areas for finfish and shellfish that support the state's commercial and recreational fisheries. These habitats are found along the state's 1,200 miles of coastline.

There are about 40 estuaries and coastal embayments and 14 salt ponds in Massachusetts. These habitats are distinct from the more open territorial waters extending approximately three miles from shore in most areas (Fig. 1). There are 48,105 acres of salt marsh, 41,514 acres of tidal flats and 18,888 acres of barrier beaches in the Massachusetts coastal zone (Table 1)[8].

Salt marshes are important features of our coast since they provide habitat for coastal marine life, produce large quantities of plant material forming the base of the food chain, lessen impacts of storms on the coast, and protect groundwater intrusion of saltwater. Extensive salt marshes are found in the Parker River-Plum Island area, North River estuary, Essex Bay, Plymouth-Kingston-Duxbury Bay, Pleasant Bay, and the Barnstable Harbor-Sandy Neck area.

Tidal flats are important habitat for many species of shellfish, act as a buffer against storms, and retain and release important nutrients originating from marshes. Extensive flats are found primarily north of Cape Cod.

Barrier beaches are integral parts of an estuary, coastal embayment, or salt pond. They separate brackish water from more salty, open coastal waters and protect marshes and other habitats from storms. Examples of barrier beaches are found in Barnstable (Sandy Neck), Wellfleet, Provincetown (the Provincelands), and Newbury (Plum Island).

Another extremely important coastal habitat is the rocky shoreline north of Boston including the coasts of Swampscott, Marblehead, Beverly, Rockport, Gloucester, and Manchester. Rocky areas provide valuable habitat, especially for such creatures as lobster and mussels.

Finally, there are rivers and streams linking lakes and ponds with the ocean. These provide habitat for important fish such as river herring, smelt, shad, and salmon which mature in the sea but reproduce in freshwater.

POLLUTION

Pollution is a rather abstract concept to most people. How is it characterized? When can it be concluded that the extent of degradation is unreasonable or unacceptable? Answers to these questions entail an examination of such things as concentrations of toxins in marine fish and shellfish relative to public health criteria, contaminant burdens in sediments, the incidence of fish and shellfish disease, and the amount and frequency of closing of productive shellfish beds due to the presence of coliform bacteria and human pathogens.

A look at these considerations indicates that the quality of much of Massachusetts' nearshore marine environment is degraded. Of note, Boston Harbor and New Bedford Harbor are seriously polluted. The following are prominent examples of what DMF believes is unacceptable pollution impacting fish and shellfish health and impacting fisheries by rendering fish and shellfish unfit to eat in some areas or creating the unwarranted public perception that all seafood should be shunned.

Boston Harbor

Boston Harbor pollution rivals some of the worst conditions in U.S. harbors and estuaries. A primary pollutant source is domestic and industrial sewage containing bacteria, viruses, heavy metals, pesticides, oil, polychlorinated biphenyls (PBC's), polycyclic aromatic hydrocarbons (PAH's) and other complex organic compounds. Antiquated sewer systems and treatment plants and the method of sewage sludge disposal significantly contribute to the harbor's pollution. Of significance, the flow from the Nut Island and Deer Island sewage treatment plants alone is 415 million gallons per day three-quarters of the average flow from all rivers emptying into the Harbor. Additionally, and just as significant, even though sewage sludge is released at the Harbor's mouth, it may not be transported away on outgoing tides. The harbor's long flushing time and landward bottom drift contribute to the retention of wastes[9].

The Massachusetts Water Resources Authority (MWRA) was established in 1984 to help solve the complex pollution problem of Boston Harbor, in part, through renovation and upgrading of the sewer systems and operation and management of combined sewer overflows. The MWRA has the monumental task of regulating an estimated 5,200 industrial users discharging into the municipal sewage system.

Fish Cancer

Boston Harbor has been included in a recent study of the prevalence of cancerous tumors in east coast, bottom-dwelling fish[10]. In 1984, at the request of the National Marine Fisheries Service (NMFS), the Division of Marine Fisheries collected 200 winter flounder from Boston Harbor near the Deer Island outfall. Scientists from NMFS and University of Rhode Island examined

flounder livers and found that Boston Harbor flounder had the highest prevalence of liver lesions and tumors when compared to flounder from other polluted areas on the east coast. Eight percent had cancer of the bile duct and/or liver. This situation contrasted with the complete lack of lesions and tumors in flounder taken from unpolluted sites on the south sides of central and eastern Long Island, Casco Bay (ME), and Georges Bank. Flounder in Boston Harbor are almost year-round residents. Their seasonal movements consist of a change in distribution from the harbor mouth to the flats and channels of the harbor; hence, they are prime indicators of the extent of local pollution.

Additional NMFS/DMF sampling in Boston Harbor this winter revealed a higher prevalence (42%) of lesions. The precise pathology of these lesions is not yet known, but it is suspected they include precancerous and cancerous lesions. More research is needed to determine the prevalence of tumors throughout the harbor system; for example, in Quincy Bay where a major recreational fishery for flounder exists.

Cancerous liver tumors are not confined to flounder of Boston Harbor. As part of a NMFS survey of fish and environmental health, Salem Harbor flounder were sampled in July 1984. Of 77 fish examined, approximately 3% had liver cancer. While this percentage is relatively small, it still raises questions and concerns. It is unknown whether this problem exists in other Massachusetts harbors and bays, and the effect of liver cancer on the winter flounder resource is uncertain, as is the potential effect on human health.

Other Indicators of Pollution

Another Boston Harbor comparison is provided by a study of biochemical and liver condition differences between winter flounder caught off the sewage outfall near Deer Island and a relatively clean area near Plymouth[11]. Significant differences existed between areas for such things as the amount of vitamin C (ascorbic acid) in the liver. The study indicated that vitamin C may be depleted in fish during stress caused by chemical pollutants. Vitamin C is essential for the detoxification of harmful substances and wound healing. Significant differences in liver abnormalities (e.g., color and cell structure) also existed between the areas.

Winter flounder provide an additional means of monitoring the health of the marine environment since this species lives in close association with the bottom where pollutants can concentrate. An indication of a degraded or polluted environment is provided by the prevalence of fin erosion disease (fin rot), a destruction of fin tissue, which is believed to be triggered by environmental stress. Heavy metals have been cited as a possible factor in the occurrence of this disease. PCB's and petroleum residues also appear to be contributing factors[12].

The harbors and coves bordering nearby urbanized areas (e.g., Boston and New Bedford) clearly show increased disease incidence

in contrast with the more offshore, but still coastal, Massachusetts waters. In a recent study[11], winter flounder were sampled for fin rot disease around the Deer Island outfall in Boston Harbor. Fin rot was prevelant in 44% of the fish sample[4] in 1979, and 10% in 1982. Flounder sampled in Clarks Cove, part of the polluted Acushnet River estuary showed a 6.4% prevelance of fin rot in the spring of 1982 and 5.6% in the spring of 1983. The prevelance of fin rot in winter flounder sampled in these two polluted coastal areas contrast sharply with observations made during DMF spring and fall bottom trawl surveys of Massachusetts coastal waters. Of the 1082 winter flounder examined from throughout state waters during the 1984 fall survey, three fish (0.3%) had fin rot.

In addition to fin rot and vitamin C levels, another indicator of environmental stress is the level of a particular kidney enzyme in winter flounder. High levels of this enzyme are believed to indicate that flounder are trying to cope with environmental pollutants (e.g., building protein and fighting infections). NMFS summer 1983 tests of winter flounder from Buzzards Bay showed significantly higher enzyme levels, similar to levels found in flounder from highly polluted New York and Delaware Bay waters[13]. Flounder from known unpolluted waters had relatively low levels. These results suggest that Buzzards Bay is developing pollution problems.

Lobster Disease

Disease problems are not confined only to fish. The prevalence of two lobster diseases has recently been documented by DMF in Massachusetts Bay and Buzzards Bay[14]. Shell disease (shell erosion and tissue destruction) and black gill disease (fouling and erosion of gills and destruction of underlying tissue) were most prevalent in and near the Acushnet River estuary, Buzzards Bay, and off Boston Harbor. There is a definite relationship between these diseases and a high level of pollution. Observations were made on 272 lobsters collected at 12 coastal Massachusetts sites (Fig. 2). The percentage of shell disease was highest (50% and 33%) near the Acushnet River and New Bedford Harbor, respectively. Black gill disease was highest in these areas (approximately 52%) and off Boston Harbor (33%). Relatively clean areas in Cape Cod Bay and east of Cape Cod had a very low prevalence of these diseases (0% shell disease and approximately 7% black gill disease).

Soft Shell Clam Blood Disease

Recent Tufts University research on soft shell clams taken from New Bedford Harbor showed widespread occurrence of a disease of the circulatory fluid (shellfish "blood")[15]. Abnormal cells of the "leukemic" type were present in 90% of the shellfish collected there in 1982 and 1983. This contrasted with an approximate 11-28% incidence in clams from Cape Cod. While no definite cause and effect relationship between harbor pollution and this disease was cited, the Tufts investigators suggested that an association existed between high prevalence of the disease and industrially contaminated locations.

PCB Contamination

PCB contamination of fish and shellfish is not a new problem for Massachusetts. High PCB levels have been responsible for the closure of the Acushnet River estuary since 1979 to some or all fishing activities depending on the location in the estuary (Fig. 3). Restrictions are greatest in New Bedford Harbor where the PCB problem was first identified in Massachusetts.

DMF testing, in cooperation with other agencies, of lobsters taken in the estuary during the winter of 1979-1980 to the fall of 1983 showed average PCB concentrations ranging from 1.0 to 4.9 ppm (parts per million); however, individual lobsters reached as high as 23.8 ppm. During this time 20% of all lobsters tested exceeded the 5 ppm state/federal public health tolerance level for fish and shellfish. Future prospects for an opening are uncertain especially since the federal standard is now 2 ppm (down from 5 ppm) and the State Department of Public Health (DPH) has recently adopted the same standard.

Recent Department of Public Health test data of lobsters collected during the spring of 1984 in Area 3 of the Acushnet River estuary revealed PCB levels in excess of 2 ppm at all 11 monitoring stations (Fig. 4). The overall average was 6 ppm.

Contact with PCB-contaminated sediments and waterborn PCB's or consumption of PCB-contaminated prey have led to the "bioaccumulation" of PCB's in valuable fish and shellfish which take up and store these substances in body fatty tissues. This is of great concern since PCB's are persistent in the environment and are possible human carcinogens. The sediments of the Acushnet River estuary and especially New Bedford Harbor have PCB concentrations ranging from a few parts per million to well over 100,000 ppm (Fig. 5). The most severe sediment concentrations are in the western and northern parts of the estuary where PCB's commonly exceed 50,000 ppm[16]. The Environmental Protection Agency considers sediment levels over 50 ppm to be hazardous waste.

PCB levels over 30 ppm also were found in three sediment samples taken in the Neponset River. This led the NMFS Habitat Protection Branch to recommend that EPA deny the ocean disposal of these sediments which were to be dredged by the Army Corps of Engineers to maintain channels for boat passage. Lower levels have been found in Winthrop Harbor, Savin Hill Cove, Dorchester Bay, and in sediment off South Boston. A primary source of the PBC's is believe to be sewage sludge. Additionally, PCB's are carried to the Harbor by tributary rivers such as the Charles and by combined sewer overflows.

PCB's are also found in the sediments of Massachusetts Bay and Buzzards Bay. One 1976 study showed that PCB's, as well as other toxic substances, were accumulating in the sediments of Massachusetts Bay[17]. This same study determined that PCB's in sediments closer to shore were at higher concentrations. More

recently, Massachusetts Bay sediment PCB concentrations were found to be 1/10 that of concentrations found at dredged material and sludge dump sites in the New York Bight Apex, a heavily contaminated coastal area[18]. A similar conclusion was reached for PAH's in Massachusetts Bay where concentrations were 1/3 to 1/2 of those found in Apex dredged material and sewage sludge dumpsites. Sediment PAH's include such compounds as benzo(a)pyrene and benz(a)anthracene (known carcinogens) and a number of other possible carcinogens and biologically active compounds[18].

Sediment Contamination and Dredging

Sediment contamination presents a major problem for dredging projects. Massachusetts coastal communities depend on their harbors for recreation, commerce, and revenue, and this utilization requires dredging of navigation channels, moorings, docking and turning areas. This dredging, as well as disposal of dredged material, raises serious environmental concerns such as potential for release of sediment contaminants (e.g., PCB's) to the water column and benthic animals at dredge and disposal sites, alteration of natural habitat for fish and benthic animals, and lack of environmentally acceptable upland, in-harbor, or ocean disposal sites for dredged material.

The amount of dredged material from Massachusetts, waters is significant. From 1960-1981 a minimum of 4,760,000 cubic yards were dredged from Beverly, Chelsea, East Boston, South Boston, Gloucester, New Bedford, Fairhaven and Salem waters. This quantity would have filled a one square mile hole 4½ feet deep. More recently, in 1983 approximately 600,000 cubic yards of sediment were dredged in the Commonwealth as part of state projects alone. The need for dredging is increasing.

Within the past 10 years, several state and federal dredging projects have involved sediments with high concentrations of contaminants such as heavy metals and PCB's. PCB's have been found in sediments of Rockport Harbor, the Neponset River, and Dorchester Bay. Additionally, heavy metals and/or petroleum hydrocarbons have been measured in areas such as Gloucester Harbor, Chelsea River, Boston Harbor, and Wellfleet Harbor. As a result of the presence of these contaminants, it is difficult to find acceptable disposal locations for dredged material.

The aforementioned examples of a polluted environment should not be taken lightly or ignored. They are signposts and illustrate the degradation of some of the Commonwealth's nearshore waters, especially its bays and harbors.

Preceeding references to wastewater-related resource problems and concerns focused on Boston Harbor. Harbor pollution certainly has been a focus of recent attention in the media and on Beacon Hill, but these problems and concerns are not unique to the Harbor. They extend to other coastal areas such as Buzzards Bay and Massachusetts Bay, as evidenced by the previously referenced incidence of tumors and fin rot in winter flounder and

shell disease and black gill disease in lobsters from these Bays. Pollution stemming from sewage discharges from sewage treatment plants, stormwater drains and combined sewer overflows is more widespread than just Boston Harbor, and may continue to be a serious threat to the shellfish in many coastal communities. Locations of major sewage outfalls and flow rates are shown in Figure 2 and Table 2.

Spread of Waste-related Pollution

Waste-related problems also are becoming more commonplace in coastal cities and towns due to population growth and a population shift to coastal areas. People have been attracted to the coast due to its resources, aesthetics, and recreational opportunities. At an ever increasing pace, the immediate coastal area is becoming more heavily developed. For example, the year-round Cape Cod population has grown by more than 50% in the last 10 years and over 40% of our state's population now lives in coastal communities.

Coastal development is accompanied by waste disposal problems, and our state's valuable commercial and recreational shellfisheries for soft shell clams, quahogs, oysters, bay scallops, and blue mussels are most affected. These resources have been afforded some protection by legislation and programs such as the Wetlands Protection Program and the Chapter 91 Licensing program of the Department of Environmental Quality Engineering (DEQE). These programs have slowed rapid physical destruction of the coastal environment by activities such as marsh removal, dredging, and ocean dumping. However, programs at local, state, and federal levels regulating the discharge of industrial and municipal wastes and the installation of septic systems have not stopped further pollution of our coastal waters by sewage and toxic chemicals.

As an illustration of the public's perception of pollution problems and their control, in a 1984 questionnaire inquiring about shellfisheries management problems and needed state technical assistance, pollution and pollution-related problems were cited by coastal communities as the number one concern by 14 towns and as a second or third concern by six towns. In an earlier 1982 survey shellfish harvesting area restrictions (closures) due to sewage and toxic chemical contamination were considered serious problems by 45% and 56%, respectively, of commercial fishermen who were queried. Sixty percent of recreational fishermen questioned thought sewage pollution was a major threat to the marine environment. Sixty-five percent also considered toxic chemical pollution to be a major threat[1].

Homes, as well as businesses, institutions, marinas, and boats are sources of sewage with attendant fecal bacteria and viruses which are accumulated and concentrated within filter-feeding shellfish such as clams. The single greatest domestic source in water adjacent to urban areas is from combined sewer overflows and municipal treatment facilities which are not func-

tioning properly. Another source which is increasing in significance in coastal regions is increased land run-off. Other sources of bacterial contamination include malfunctioning septic systems, and animal feces. The latter may be introduced either directly by large numbers of waterfowl and seabirds or indirectly via surface run-off especially during and immediately after storms. Waterfowl populations have increased in some areas due in part to feeding which concentrates birds in small areas and creates resident populations.

The significance of "non-point" sources of contamination was highlighted in a March 1985 Barnstable County Health and Environmental Department Report entitled "Bacteriological Quality of Shellfish Harvesting Areas in Barnstable County, Mass. 1984". In reviewing contamination problems in the waters of Barnstable County, the Department stated that "the primary threat to the water quality in marine coastal environments is non-point pollution". The Report identified four non-point discharges as primary sources of bacteria in coastal waters - stormwater runoff, wildlife, failing septic systems, and discharges from boats and marinas. Stormwater is the major source of pollution in both urban and rural areas as it is discharged untreated into coastal waters. In addition to bacteria, stormwater runoff carries organic and heavy metal contaminants, particularly from roads and parking lots.

The Barnstable County report also stated that "land use surrounding shellfishing areas and contributing waters is likely the single most important factor in determining water quality". As stated earlier, the Massachusetts coastal zone is becoming more developed. The year-round population of Cape Cod has grown by more than 50% in the last 10 years. Uplands adjacent to coastal ponds and estuaries are in great demand, and much already has been developed. Massachusetts' environmental regulations exist to protect wetlands and other sensitive coastal resource areas, but the regulatory system does not provide enough protection of adjacent uplands. Towns can provide more protection through their zoning power and the local Boards of Health authority.

CZM

Shellfish Contamination

The incidence of and trends in shellfish contamination due to fecal coliform bacteria are keys to a better understanding of what is happening to our coastal waters and resources. What follows is an alarming account.

In the decade between 1970 and 1980, there was little change in total amount of open and closed shellfishing areas on the South Shore and in Southeastern Massachusetts (from the Hull-Cohasset town line to the Mass/R.I state line). A total of 19,891 acres were closed to the harvest of shellfish for public health reasons at the end of 1980. Much of the closed area was in the vicinity of highly urbanized and/or industrialized areas of Taunton River/Mt. Hope Bay, New Bedford Harbor/Clarks Cove,

Plymouth Harbor and a number of smaller harbors including Falmouth Harbor, Hyannis Inner Harbor, Cohasset Harbor, and portions of Provincetown Harbor. Numerous smaller areas also added to the total.

The situation remained much the same throughout 1981 and early 1982. However, by the end of 1982, DEQE reclassified and DMF subsequently closed an additional 2,038 acres to shellfishing. By November 1, 1984 another 3,469 acres were closed. Consequently, during that two year period 5,507 acres (8.6 square miles) of coastal waters were closed to shellfish harvesting due to bacterial contamination. This brought the total area closed to shellfishing to 25,398 acres in the southeast region of our state and represented a 27.7% increase over the 1980 total. These additional closures affected 17 communities, 15 significantly (20 or more acres) and for the most part were in suburban areas not serviced by municipal sewage treatment plants.

In particular, on Cape Cod acreage has been closed in 14 new areas and six closed areas have been expanded since 1982. Between new and expanded closures, 1,390 additional acres have been lost to fishing. Added to 712 acres previously closed, the total closed area on the Cape is about 2,102 acres - a 200% increase since 1982. A particularly ironic event was the closure of the Pocasset River area to shellfishing in October 1984. This area had been classified by the state a few years ago as "an area of critical environmental concern."

Other major closures have occurred in what were once considered relatively unpolluted areas. In picturesque tidal rivers like the Westport (630 acres) and the North and South Rivers (2,400 acres) in Marshfield and Scituate, a total of 3,030 acres were closed in 1984. Ten years ago, the 13 mile North River was designated as one New England's cleanest rivers. A listing of closures by town and region are provided in Tables 3 and 4.

In contrast, on the North Shore and in Boston Harbor the situation is not quite as bleak in terms of new closures. Nonetheless, the present status quo is already worrisome to those concerned about shellfish harvest and public health (Fig. 6) For many years all of Boston Harbor has been closed to the harvest of shellfish except in certain areas classified as "restricted". In these areas specially-licensed diggers harvest "moderately contaminated" (with coliform bacteria) soft shell clams for purification at the state-operated purification plant in Newburyport. The amount of productive shellfish area classified on any given day as "restricted" is about 2,864 acres. In Boston Harbor about 1,826 productive acres are closed (prohibited) at all times. Portions of the 2,864 acres classified as "restricted" may temporarily revert to the prohibited status on a daily basis depending on sewage treatment plant malfunctions and stormwater bypassess. There are no open areas in the Harbor. Consequently, adjacent waters of Boston, Milton, Quincy, Hull, Braintree, Weymouth, Hingham, and Winthrop are closed or restricted. This totals 4,690 productive acres (7.3 square miles).

Like Boston Harbor, much of the North Shore has been closed for many years. Of the 3,514 productive shellfish areas, 1,576 (44.9%) are prohibited and 514 are restricted (14.6%). Hence, only 1,424 acres (40.5%) of productive flats are open. The only improvement is that since 1981 some prohibited productive acres have been reclassified as restricted: Newburyport (1981) 77 acres; Ipswich (1982) 124 acres; Gloucester (1983) 56 acres. Still, the combined total productive shellfish flats closed (or restricted) from Boston Harbor northward amounts to 6,781 acres (10.6 square miles) (Table 5).

The foregoing refers to closures of productive areas; that is, intertidal flats with commercial quantities of soft shell clams. In addition to these areas, however, there are about 18,000 nonproductive acres closed because water quality does not meet shellfish growing area standards. Species of value such as blue mussels, surf clams, and ocean quahogs are found in portions of these 18,000 acres. Taken together, the total area under a public health closure on the north shore and in Boston Harbor amounts to 24,780 acres (38.7 square miles).

Of the closed area south of Boston, about 80% (20,318 acres), is considered productive since the shellfishery is diverse and not confined to an intertidal soft-shell clam fishery. Quahogs, oysters, soft-shell clams, and mussels are found in both intertidal and subtidal waters while bay scallops, surf clams, and ocean quahogs are harvested in subtidal waters.

Important commercial and recreational shellfish areas have been closed resulting in heightened fishing pressure on remaining open areas and adverse social, economic, and biological impacts. The expansion of closed areas due to bacterial contamination, especially in Southeastern Massachusetts is indicative of a serious problem and graphically illustrates the degradation of our coastal waters, precluding their use for commercial and recreational fishing. Since recently increased monitoring may be partly responsible for the increase in closures, there could be many other areas which are contaminated but mis-classified due to insufficient monitoring. Bacterial contamination of coastal waters is more widespread than realized.

Pesticides

Bacterial contamination is not the only concern related to shellfish and its harvest. Synthetic pesticides (insecticides, fungicides, herbicides, and rodenticides) pose a direct threat to our state's shellfish resources since they can cause direct mortality or impair the survival of shellfish. Currently the major sources of pesticides are agricultural run-off from uplands and bogs and individual use on lawns and gardens.

The major agricultural activity in the coastal region of Southeastern Massachusetts and on Cape Cod is the cranberry industry. Cranberries are grown in bogs where large amounts of water are used for irrigation. The cranberry industry uses of

insecticides, fungicides, and herbicides to maintain and increase production. Many of these pesticides were developed for agricultural use on dry land and carry warnings on their labels against application over open water or near streams, ponds or estuaries. In addition, labels state that many of these pesticides are highly toxic to fish, shellfish, crabs, and shrimp. A few examples are Parathion, Carbaryl (Sevinol 4), Roundup, and Difolatan.

Most major watersheds in Buzzards Bay and on Cape Cod drain large areas of cranberry bogs. Pesticides from bogs are carried by these rivers and streams into the coastal waters where they can cause acute, immediate fish and shellfish mortality and sublethal effects such as reduced reproductive success. Regarding the latter, pesticides are known to hinder shellfish embryonic development and reduce laral survival.

With the cranberry industry's current success resulting from expanded markets, the demand for and price of berries has increased dramatically, and this has encouraged growers to increase production in existing bogs through application of pesticides. Furthermore, bog acreage is being expanded where possible through reclamation of abandoned bogs or creation of new ones.

While the characteristics of the pesticides used, application methods (holding water in bogs), and simple dilution minimize the potential for significant pesticide residues reaching coastal waters, there is evidence that not all cranberry growers use proper application methods. For example, a recent fish kill in Falmouth was caused by improper pesticide application. There is a need for more monitoring of application methods and enforcement of existing regulations.

Moreover, there is a need to consider charges in licensing requirements. Currently there are no licensing requirements (e.g., classes and testing) for bog owners who apply their own non-restricted pesticides, and accounts of the amount of pesticides applied to bogs must be derived from owners' spraying records and cannot be verified. Bog owners applying their own restricted pesticides (e.g., parathion) must make their records available to the state's Pesticide Bureau on request. Still, there is potential for abuse. More monitoring and enforcement is needed.

Acid Rain

A final example of environmental degradation is acid rain. Acid rain is a term for an insidious form of air pollution. The effects are generally not immediate, but slow and cumulative. It kills by chemically altering the environment. The fog, rain, and snow that falls in Massachusetts are weak solutions of sulfuric, nitric, and hydrochloric acids between 40-100 times more acidic than "normal" rain.

The extent to which acid precipitation impacts aquatic ecosystems is dependent on the geochemistry, geomorphology, and

hydrodynamics of the system. Due to soil properties, bedrock geology, climate patterns, and vegetation types, many areas of the Commonwealth, especially Cape Cod and other southeast regions are highly sensitive to the effects of acid rain. Within Bristol County sixty percent of the water bodies (streams, lakes, ponds, etc.) are classified as acidified or critical, endangered, or highly sensitive to acidic precipitation. Twenty-two percent of all Massachusetts water bodies are either acidified or critical.

The exact magnitude of the acid rain problem on the 17 species of diadromous fish (fish that move between fresh and salt water) which frequent waters of the Commonwealth is unknown. The potential for major impacts on the spawning, survival, and growth of these species is great, however. Species such as river herring and shad leave their buffered, ocean environment and enter coastal streams and rivers during times of the greatest acidification impact. The acidity and metal loading from winter snow melt and heavy spring and fall rains place spawning fish in an environment where harmful conditions are maximized and fish life stages (weakened, spent adults, fertilized eggs, and newly hatched larvae) are most susceptible and intolerant. Consequently, diadromous fish that are important to the state's commercial and recreational fisheries are susceptible to the effects of acid precipitation.

Currently, many stream, pond, and lake habitats lack historical or temporal data for determination of acidification trends. Regardless, it is clear that these habitats are being altered. A number of species have suffered significant declines in abundance along the Atlantic coast (for example, striped bass). Acid rain may be a major factor contributing to these declines.

HABITAT LOSS AND DEGRADATION

Massachusetts was one of the states to pioneer laws protecting wetlands. The Coastal Wetland Protection Act (Chapter 131, Section 40) was passed in 1963 and the Coastal Wetlands Restriction Act (Chapter 130, Section 105) was enacted in 1965. The wholesale loss or alteration of coastal habitat has been arrested in large part as a result of these two laws. However, there is still small-scale loss of coastal habitats. What follows is an account of how this small-scale loss may occurs.

There are seven interests under the Wetland Protection Act that must be protected. To afford this protection, local Conservation Commissions condition or deny projects affecting wetlands. Unfortunately, in some towns both project proponents and Conservation Commissions frequently misunderstand the existing regulatory standards and/or lack the expertise to properly assess projects' potential effects on wetlands. Conservation Commissions are composed of volunteers often with no technical background or professional staff to assist them. As a consequence, local Conservation Commissions may allow projects

resulting in small losses of wetlands; for example, filling along the inland edge of the wetland that encroaches into a marsh, or dredging an area that is on or abuts a productive shellfish area. Furthermore Conservation Commissions can allow dredging in shellfish areas if the applicant transplants the shellfish or purchase stock for the town. Little monitoring has been done however, to determine survival of shellfish transplanted for small dredging or marine construction projects. Transplants may result in significant shellfish mortality.

The regional offices of DEQE review Conservation Commission Orders of Conditions, review appeals by aggrieved parties to these decisions, and may themselves appeal local Order of Conditions if DEQE believes them to be inadequate. However, reduced staff levels and increased permitting (development) activity make it difficult for DEQE to carefully review each of the nearly 5,000 Order of Conditions issued statewide.

Wetlands in Massachusetts can also be protected by the Wetlands Restriction Program. The Program offers strong protection because it stipulates on the property deed what is allowed and prohibited in wetlands areas. The Program allows the state to set orders regulating, restricting, or prohibiting dredging, filling, removing, or otherwise altering or polluting coastal wetlands. Once an order is established, it is recorded with the Registry of Deeds or the Land Court. Unfortunately, the Program has not been pursued aggressively. Of the approximate 90,000 acres of saltmarsh and tidal flats in this state, only about one third have restrictions of one kind or another. More effort is needed through deed restrictions to protect the additional 58,000 acres.

The recent resurgence of recreational boating also is contributing to small-scale habitat loss. More people owning waterfront property want docks for their private craft. Consequently, there are more private docks and more requests for alterations and expansions to existing docks in communities like Falmouth, Bourne, and Barnstable. The problem lies not with individual projects, but with the cumulative effect of a number of similar projects, throughout a tidal river or embayment. Once one individual is allowed to build a private dock, it becomes difficult to deny another request for a nearby dock. Each of these projects often involve dredging 200-1,000 cubic yards of material. The net effect of this activity is a potential for destruction of fisheries habitat resulting from dredging. Furthermore, boat propellers often are used to create turbulence to re-dredge or deepen an area. Washed-out silt and sediment may then settle on adjacent shellfish beds and cause damage or destruction by smothering.

A review of "Notices of Intent" (NOI) and "Orders of Conditions" (OOC) reveals how often pier construction or modification with dredging occurs. It also provides some indication of interest in coastal development. For example, in 1983 in the town of Barnstable, 152 NOI were filed (as required by the

Wetlands Protection Act). Twenty-two were for coastal construction/alteration and/or dredging. Orders of Conditions were issued for 19 (2 were withdrawn and one was denied). Of these 19 projects, 7 involved dredging. In 1984, 136 NOI's were filed; 40 were for coastal construction/alteration and/or dredging. One request was denied and the other 39 were issued OOC's. Thirteen involved dredging. An example of how these projects become cummulative is provided by Cotuit Bay. In 1973, 14 of the 19 approved projects were in this large estuarine system on the south side of Barnstable.

The gradual loss of wetlands is difficult to document. There have been three studies to delineate the acreage of wetland types in Massachusetts, and two of these have been time series to determine the loss of acreage. However, these two studies have not used the same methodology and therefore the results cannot be compared. Little information is available concerning the amount of saltmarsh loss due to illegal dredge and fill operations. While it is unlikly that there are major losses, the state is aware of small, less than one acre, illegal projects. In addition, some loss of coastal wetlands may occur from public projects, such as bridge construction, since the Legislature has exempted these projects from the jurisdiction of the Wetlands Protection Act.

The gradual disappearance of wetlands from man's activites is a serious problem that cannot be ignored. In 1972, in amending the Wetlands Protection Act, the Massachusetts Legislature identified seven public benefits of wetlands: flood control, storm damage prevention, public or private water supply, groundwater supply, prevention of pollution, protection of fisheries and protection of land containing shellfish. Recently, an important value of wetlands was highlighted by the U.S. Fish and Wildlife Service[19]. The Service cited benefits of a South Philadelphia 512 acre tidal marsh system into which three sewage treatment plants discharged sewage. The marsh removed 7.7 tons of organic matter, 4.9 tons of phosphorus, 4.3 tons of ammonia, and 138 pounds of nitrate daily. It also added 20 tons of oxygen to the water. The marsh served as an effective device for water pollution control and enhanced water quality. This is just one important function of wetlands.

EXCESSIVE FISHING

Excessive fishing is another serious threat to the Commonwealth's finite fisheries resources and to the fishing industry itself. Excessive fishing is caused by too many fishermen and fishing vessels with high fishing power, all competing for their "share" of the resources. Excessive fishing is also caused be ineffective fisheries management stragies due to inadequate planning and insufficient law enforcement. This leads to reduced fish abundance, less landings, smaller and often immature individuals being landed, and economic problems for the fishing industry.

Evidence of the adverse effects of excessive fishing and ineffective fisheries management on Massachusetts' fishing industry abound. A series of recent newspaper articles highlight the problem that exists, not only in Massachusetts but in all of New England as well: "New England Fishing Poor" and "Fishing Fleet Struggles to Stay Afloat" (Cape Cod Times, 9/84 and 5/84), "Hard Luck, Hard Times Chip Away At Provincetown's Fishing" (Cape Cod Business Journal, 4/84), "Decline and debate pervade New England groundfishery" (National Fishermen Yearbook 1985), "Sea scallops continue to decline" (Commercial Fisheries News, 5/85). These headlines reflect a substantial problem.

Documentation of reduced fish abundance is available from Massachusetts and federal fish population surveys, observations of fishermen, and trends in landings. For example, haddock total 1984 U.S. landings from Georges Bank were 30% of 1982 landings and 50% of 1980 landings. The population (in terms of weight) declined 75% from 1980-1983[20]. Haddock reproduction from 1979 to the present time has been so poor that prospects for the next few years look very dim. The situation for Gulf of Maine haddock also is not promising; e.g., from 1983-1984 landings dropped 50%. Haddock is an important component of Massachusetts' fishermen's catch.

Sea scallops, the species primarily responsible for New Bedford's 1984 ranking as the number one port in the nation in terms of value, have been reduced to very low levels of abundance. U.S. commercial catch per effect (a good indicator of the status of a fishery and its resource) was 22% lower in 1984 than in 1983 (43% lower than in 1982) and was the lowest observed from 1965-1984. Landings in the traditionally most productive portions of George's Bank decreased 29% from 1983 to 1984 (53% from 1982). Federal surveys indicate that on Georges Bank and in the Mid-Atlantic area (where scallop catches were once high), scallop abundance will remain poor in the near future. Additionally, in the Gulf of Maine the commercial sea scallop fishery will become more dependent on inshore beds in territorial waters since no important beds of scallops in deeper offshore waters appear to exist[21].

The resource status described for haddock and scallops typifies the situation which exists in Massachusetts now. High value, desirable species have been fished down to low levels of abundance, and there are no foreseeable prospects for improvement. Consequences are: 1) a shift of effort by the highly mobile and efficient Massachusetts fishing fleet to other species (e.g., winter flounder and yellowtail flounder) thereby stressing these species too: and, 2) a shift to inshore areas thereby increasing competition with and worsening the economic plight of smaller, inshore, day-trip vessels dependent on finite resources of fishing grounds in or near Massachusetts waters. This movement inshore and to other species has also created serious conflicts between commercial draggers and fixed gear fishermen (e.g., lobstermen) and has ignited conflicts between commercial and recreational fisheries interests (e.g., competition for

grounds in traditional recreational fishing or party boat fishing areas).

The shift to inshore fishing areas for flounders and other species is one of the primary problems confronting our inshore resources. In particular, winter flounder, a mainstay of Massachusetts commercial and recreational fisheries, has shown a constant decline in abundance of juveniles and adults in Massachusetts territorial waters. While the exact cause for this trend cannot be pinpointed, it is likely related to the substantially increased catch of winter flounder in recent years. An all-time high U.S. commercial landing of winter flounder was approximately 38.6 million pounds in 1980 and 1981. Landings were similar in 1982 and 1983 (34 million). However, the percentage of small and "pee wee" fish in landings has increased since 1975 while the "large" market category has declined, especially for fish caught off southern New England[22]. This change in size distribution of landings is indicative of a serious resource problem. Furthermore, winter flounder is no longer incidental to the catch taken when fishing for other species. The percentage of fishermen directing their effort towards winter flounder, especially offshore, is increasing. Relatively high landings of winter flounder are maintained by increasing fishing effort and catching many small fish.

The status of other species in Massachusetts waters is documented by DMF's semi-annual state waters survey. DMF's spring 1984 survey findings were alarming. Dramatic declines in several species were found. For example, the lowest catch (number of fish) in five years was recorded for cod, pollock, fluke, and windowpane flounder. Small scup (pre-recruits) were at their lowest level in five years. Black sea bass abundance was down 63% from 1983. American plaice (dab) was near a five year low.

DMF's fall 1984 survey preliminary results were just as grim and documented the continued decline in fish stocks and discouraging prospects for future recruitment. For example, winter flounder declined about 48% from 1983 and the previous six year average; pre-recruits decreased 59% from 1983. Pre-recruit-sized scup, butterfish, black sea bass, and longfin squid decreased 35%, 71%, 49%, and 70%, respectively.

Fishermen's observations are a vital component of an assessment of the status of any resource. Their observations support evidence presented by the more scientific assessment process. For example, one New Bedford fishermen was quoted as saying, "It's the worst summer I've seen in 14 years of fishing for cod and flounder" (Cape Cod Times, September 1984). An experienced, long-time inshore fisherman found flounder fishing in Massachusetts waters to be pitifully poor. Many Provincetown fishermen recently considered selling out and getting out of the fishing business due to low catches and poor prices. Some claimed that the conditions in the fishery, particularly inshore, were only worse prior to the implementation of the Magnuson Fishery Conservation and Management Act of 1976 when foreign

fleets overfished fish stocks off New England. Even after accounting for exaggeration, it is clear that fishermen are spending more time to catch less, and this trend will continue until resources off our coast recover at a time very much uncertain.

Excessive fishing has created a situation in which the fishing industry is: (1) more susceptible to economic hardships caused by contaminated (actual or perceived) resources (e.g., consumer fear/avoidance and decreased market demand); (2) put at a competitive disadvantage with other countries sharing the same or seeking new markets; (3) more resistant to state and federal management resource recovery strategies; (4) less able to make needed capital investments to maintain safety and longevity of vessels; and (5) increasingly stressed by high insurance costs. Excessive fishing also leads to increased competition between individual fishermen and between states (e.g., New Bedford vs. Point Judith) for slices of a "resource pie".

OTHER FISHERIES IMPEDIMENTS

In addition to obvious effects of pollution, habitat loss, and excessive fishing on our state's fishing industry, our industry is being adversely effected by loss of opportunities caused by: 1) inadequate port facilities; 2) inadequate public access; 3) Canadian competition for U.S. markets; 4) the new U.S./Canada boundary which apportions Georges Bank between the two countries; and 5) insurance costs.

Inadequate facilities. To take advantage of available resources and to have viable businesses, fishermen from rural fishing ports such as those of Cape Cod and from metropolitan ports such as Boston, must have basic fishing facilities. Minimal requirements include safe berthing; ample pier or bulkhead space to offload fish and take on gear and provisions; adequate access to and from the harbor; and if possible, storage space for fishing gear. Support facilities such as fuel, ice, and ships chandlers are equally important. These facilities are woefully inadequate in many Massachusetts ports; e.g., Hyannis.

Our ports and harbors were originally designed and built around fishing industries and sea-going trade. The Boston waterfront attests to this fact with its host of long wharves and old waterfront buildings, many of which have been converted to expensive condominiums, motels, or office space. For example, about one-third of Boston's lobster fleet (88 vessels) recently was forced to relocate. With few exceptions, problems facing almost all of the coastal fishing ports and harbors in Massachusetts are very similar - a struggle to maintain or rehabilitate existing facilities.

Like Boston fishermen, commercial fishermen in at least 10 ports and harbors on Massachusetts' South Shore for the past several years have struggled to compete with interests of greater financial resources and/or local politics. Competition with

recreational boaters for limited space also has been a source of conflict in some instances. Recent events in towns such as Scituate, Provincetown, Harwich, and Hyannis serve as examples of fishermen's attempts to gain town funding for minimal improvements to existing facilities. Most of these attempts have ended in failure. For example, one publically funded feasibility study and another private proposal projected the economic and tourist benefits to Hyannis and its fishermen of minimal upgrading of commercial fishing facilities. The Hyannis commercial waterfront has not undergone any necessary improvements.

There is rarely any problem in appropriating money for feasibility studies in Cape Cod ports to explore minimal improvement to commercial fishing facilities. Unfortunately, planners and developers usually consider large expansion projects rather than address critical day-to-day needs of the fishing industry. Despite studies documenting the year-round benefit of commercial fishing bases to local economies, fisheries must continually prove their worth and deal with competitors such as seasonal tourist-related interests.

Inadequate public access. Inadequate public access is a serious problem for recreational fisheries, and the problem is growing. Some of these problems are discussed below.

With increased use of trailered boats, there is a need for more boat ramps, repairs to existing ramps, and parking areas. However, in the last five years the state Public Access Board has built only tree new saltwater ramps. Six ramps have been repaired, and additional parking has been added at only three sites.

Many recreational fishing sites accessible 20 years ago are now unavailable to fishermen. Shorefront development generally is the culprit. Many areas are now fenced off or are posted to trespassing. Although a coastwide problem, it is most noticeable on the south side of Cape Cod. Almost all the coastline from Woods Hole eastward to Chatham is privately owned and public access is severely restricted or prohibited.

Access on publicly owned land is also limited. Parking at night at state and town beaches where surf and jetty fishing takes place is now prohibited in many areas. Of the 13 towns that border Buzzards Bay and Nantucket Sound, six do not allow parking after swimming beaches close. While state parks at Plum Island, Salisbury, Halibut Point, and Lynn do allow vehicular access at night, most parks in southeastern Massachusetts do not allow access. Dighton Rock, Fall River Heritage Park, Horseneck Beach, Demerest Lloyd, and Fort Phoenix, are all closed at night. South Cape Beach and Scusset Beach in Sagamore are the only exceptions.

More and more piers and docks are being closed to the public. For example, in Boston several piers, that at one time provided sites for recreational fishermen, were rehabilitated with public

funds, and condominiums were built. Now, guards stand at entrance gates to the piers and allow only condo residents to enter.

Recreational fishing is an important attraction of Massachusetts. Opportunities for recreational fishing have been and are being lost.

Canadian Competition. The presence of Canadian fresh and frozen groundfish in the New England marketplace is nothing new. Canadian groundfish have been exported to major U.S. markets for at least 30 years. However, over the last four or five years Canadian imports have reached unparalleled levels (Fig. 7). For example, imported Canadian fresh cod fillets totaled 1.5 million pounds in 1974. This figure rose to 7.9 million pounds in 1982, slightly more than a 400% increase. During the first half of 1984, imports of fresh cod fillets approached the total volume of 1982 imports (Fig. 8). This is significant since prior to 1983, the majority of imported groundfish products from Canada was in frozen form. Canada now is attempting to make further inroads into the U.S. fresh fish markets of domestic producers. Ninety percent of Northeast U.S. production of groundfish is marketed in fresh form.

The U.S. is an extremely important market for Canadian exports of groundfish. During 1979-1983 86% of the quantity and 89% of the value of Canadian imports of groundfish were marketed in the U.S.[23]. These products compete with Massachusetts production thereby hindering our state's efforts to expand or even maintain existing markets. Many Massachusetts companies no longer enjoy a domestic distribution advantage because Canada now air freights direct to most major U.S. cities. This is a recent phenomenon.

One aspect of this competition deals with ex-vessel prices or prices paid to fishermen. Canadian ex-vessel prices in 1983 for cod, haddock, flatfish, pollock, and sea scallops were significantly lower than prices paid to U.S. fishermen (Fig. 9). Consequently, Canadian suppliers can and do undersell U.S. suppliers in the U.S. domestic market. For example, during a recent International Trade Commission hearing, a Boston fish broker stated that his New England business accounts dropped from 60% to 2% in the last 10 years due to undercutting by Canadian fish prices. He now must air freight outside New England at greatly increased cost[24].

The Commonwealth's fishing industry has objected to the unfair market competition presented by Canadian imports. Our industry has emphasized the many forms of Canadian government assistance (grants, loans, subsidies) to their industry. For example, massive infusions of federal Canadian dollars during 1983 were used to restructure, or bail out, two of Canada's largest processing companies.

Our industry was so concerned about its unfavorable competitive position that it recently joined forces with other sta-

tes' industries to request the federal government to investigate impacts of Canadian imports on New England. An International Trade Commission fact finding investigation was initiated in response to this request, hearings were held, and a final report was released.

Three of the ITC's more noteworthy conclusions were:
1) Atlantic Canada producers hold a price advantage vis-a-vis New England U.S. producers at the ex-vessel and wholesale levels for groundfish and scallop products;
2) Government assistance programs appear to favor foreign producers particularly in Atlantic Canada;
3) Canada was the principal supplier of New England groundfish and scallop imports during 1979-1983.

The New England fishing industry, with Massachusetts in a leading role, has petitioned the federal government for protective relief (e.g., tariffs), and the International Trade Commission recently voted in it's favor. The ITC concluded that there was reasonable evidence that the Northeastern U.S. fishing industry is suffering injury through imports of fresh groundfish from Canada. The Commerce Department's International Trade Administration will try to determine the level of Canadian government subsidies. The New England fishing industry is seeking countervailing duties of 10-20% on fresh, whole, filleted cod, haddock, pollock, hake, and flatfish. It is not yet known if the ITA will conclude that these levels of duties are appropriate.

U.S./Canada boundary. The recent World Court boundary decision giving productive George Bank fishing grounds to Canada is a good example of loss of opportunity (Fig. 10). Unless some kind of reciprocal fishing rights are agreed to by both countries, Massachusetts and other New England fishermen traditionally fishing this area for species such as haddock, scallops, lobsters, and swordfish will have to fish elsewhere. Presently, any kind of agreement appears to be far from completion and implementation.

Our fishermen's exclusion from the Northeast Peak and Northern Edge of Georges Bank will deny them access to one of the few areas showing promise for increased sea scallop abundance. A National Marine Fisheries Service 1984 survey of scallop grounds off New England indicated that "exceptionally large recruitment" of the 1981-born scallops had occurred on the Peak and Edge. Elsewhere off Massachusetts, abundance was decreasing or showing no change.

As a result of loss of these important and promising fishing areas, effort of larger vessels will be displaced towards shore thereby worsening the status of the Commonwealth's inshore resources, heightening competition with smaller vessels dependent on those resources, and causing user group conflicts (e.g., lobstermen vs dragger fishermen). Vessels normally fishing farther offshore have already been seen fishing off the eastern side of Cape Cod and elsewhere inshore.

Insurance

The difficulty of securing insurance for fishing vessels has been increasing in recent years. Because of sinkings and large cash settlements received by injured fishermen, insurance companies are either refusing to issue insurance or are significantly increasing premiums. Consequently, fishermen are forced to remain at the dock, pay the high premiums, or fish without insurance. For example, this June approximately 80 Cape Cod fishermen had their insurance cancelled. One fishermen was quoted by the Cape Cod Times (6/28/85) as saying that his policy would be rewritten only if the premiums were increased by 110%. This added expense is forcing many fishermen deeper into their own financial crisis.

REGULATORY, MANAGEMENT & RESEARCH CONCERNS

Massachusetts has established a fairly sound legal and regulatory framework for environmental issues. In order to fully utilize it and keep pace with the increasing adverse impacts on marine resources, several problems must be addressed: adequate budgets and staffing must be provided; new policies must be developed; policy conflicts must be resolved; research and monitoring efforts must be enhanced and coordinated; and, general cooperation among all parties must be improved. The following accounts describe various aspects and needs of these problem areas.

Federal and state pollution abatement strategies have traditionally focussed on point sources of pollution. Recent information has begun to demonstrate the significant amount of pollution contributed to water bodies by non-point sources. Regulatory programs and policies need to respond accordingly especially in coastal waters.

DEQE conducts sanitary surveys of shellfish growing waters and in the process, looks for pipes, sewage outfalls, visibly failing septic systems, storm drains or culverts and the presence of wild or domestic animals and waterfowl. Potential sources of contamination are noted. This information is provided to the affected municipality and typically is accompanied by enforcement actions. The coastal city or town must rectify the pollution problem itself by, for example, the local board of health. However, when sources are not identified or when the source is non-point in origin, such as run-off from surrounding upland, or is of mixed origin, (human and animal), then abatement by a local cummunity may be difficult. Often in situations such as these, not only are the source or sources of pollution difficult to identify, but they may extend beyond the boundaries of one or more municipalities. Furthermore, the funding and expertise needed to determine the exact cause of the problem and carry out pollution abatement procedures may not exist locally. Problems then worsen, and communities must seek outside help from private consultants. Consequently, progess in rectifying these complex and costly problems are slow to occur. There is a need for addi-

tional technical and financial assistance at the local and regional levels for identifying and implementing solutions to non-point sources of pollution.

The Environmental Protection Agency (EPA) and the Division of Water Pollution Control (DWPC) have primary responsibility for pollution abatement and control from point and non-point sources. They have focussed efforts over the years on point source discharges and have led to the construction and maintenance of sewage treatment plants as mandated by the federal and state Clean Water Acts. Overall, Massachusetts has achieved significant success at cleaning fresh water, as evidenced by the return of Atlantic salmon to the Merrimack and Connecticut Rivers. A similar effort for point source discharges is proceeding with regard to our marine waters, but additional work is necessary to identify and abate non-point sources along our coastal areas.

A second problem relates to insufficient staffing, lack of specific federal standards for many toxics, and extraordinary reporting difficulties leading to dificiencies in the state's present industry compliance monitoring system and the state's knowledge of the sources, total volume, and composition of wastes. EPA and local governments currently have primary responsibility for implementation and enforcement of the industrial pretreatment program. DWPC works with the EPA and communities on funding, siting and construction of municipal wastewater treatment plants and the development of local pretreatment programs. Compliance monitoring is the responsibility of the plant operator who must monitor the discharge from the treatment plant for priority pollutants specified in its discharge permit. These compliance reports are submitted monthly to EPA and DWPC. A major drawback of this procedure is that industries discharging into a treatment plant monitor their own discharges and report results to treatment plant operators. Considering the possibility of industry abuse of this honor system, it would appear that the system is flawed. Furthermore, DWPC currently has no direct means of identifying all of the industry dischargers and consequently is unable to easily identify the number one volume, and composition of industrial discharges into state waters.

DWPC is currently negotiating with EPA for responsibily of the permits and industrial pretreatment programs. This will significantly increase the state's industrial data retrieval capabilities but will also require a significant increase in personnel and data management systems. The state's existing compliance monitoring generally is confined to a review of the monthly reports from treatment plant operators, periodic inspections of the treatment plants and bi-annual sampling and analysis of the plants' effluents. Periodic water quality surveys of the major river basins and some coastal systems are also done. While this procedure includes monitoring of individual discharges, the extent of monitoring is insufficient to ensure full industrial compliance.

The complexity of managing the competing uses of marine resources is occasionally reflected in policies that seem to be

at cross-purposes. For example, the apparent conflict in the Wetlands regulations concerning barrier beaches and projects related to enhancement of marine fisheries. Specifically, situations arise where salt ponds with unstable inlets begin to close and tidal exchange is reduced or ended. Many of these ponds have, or could have, significant shellfish and finfish populations if their openings to the sea were seasonally maintained. However, because of the regulations governing barrier beaches and dunes, it is difficult to get permission to maintain tidal exchange into such ponds. This is, and will continue to be a problem on the south side of Cape Cod, the Islands, and Buzzards Bay where salt ponds exist. Resolution of this problem will involve rewriting the regulations in a manner that balances the public interest of fisheries enhancement and storm damage prevention in these hazard prone areas.

While shellfish habitat is afforded protection under the coastal regulations of the Wetlands Protection Act (WPA), prohibitions on permanent alterations or destruction of this habitat can occur only if it is mapped by DMF. Unfortunately, the mapping of shellfish habitat cannot be routinely preformed due to lack of funds and staff. Thus, a direct way to enhance the protection of shellfish habitat by utilizing existing statutory authority cannot be effectively used.

Another problem regarding shellfish is the shared jurisdiction of four state agencies in the regulation and management of contaminated shellfish and their habitat. Briefly, DEQE classifies shellfish areas, DMF regulates access to restricted areas by openings and closures, DLE enforces closures, and DPH monitors the marketplace and imposes closures based on threats to the public health. This dispersion of responsibilities has created serious problems in communication and coordination and considerable confusion for communities and fishermen. The entire issue of shellfish contamination needs to be closely examined, and workable solutions to the problems must be implemented.

EOEA agencies are responsible for various development activities along the coast including boat ramps, marinas, and commercial fishing facilities. Because all these activities sometimes are located in or near coastal wetlands, each may result in the cummulative degradation of coastal habitat. Unfortunately, public agencies which are mandated to both protect natural resources as well as promote public access and waterfront development can act in contradictory ways. Often, this inconsistency in actions is attributable to a failure to adequately consider alternatives which reduce or eliminate impacts on coastal wetlands areas.

Implementation of the Wetland Protection Act is primarily a municipal responsibility. Appeals of local decisions are resolved by the regional offices of DEQE. This decentralized administrative organization offers numerous advantages but also can result in inconsistent decision-making. Improved policy guidelines and training for decision-makers are needed to reduce these difference.

Illegal alterations of wetlands remains a serious problem, as well. Improved coordination between local, state, and federal agencies is required if habitat protection programs are to be strengthened. In addition, existing law enforcement personnel in EOEA agencies should be utilized to more actively protect a broader range of environmental interest.

The Division of Marine Fisheries is the lead agency in the Commonwealth for the management and enhancement of marine fisheries resources and the promotion and development of commercial and recreational fisheries. Concerning shellfisheries, DMF has provided municipalities with technical assistance since 1966 and financial assistance (approximately $300,000 annually) since 1974. It promotes development of management plans and utilization of contaminated shellfish through transplants for natural depuration, propagation, and restocking. The DMF also has managed and assisted coastal communities manage moderately contaminated soft-shell clam fisheries.

Since 1966, local shellfish management has improved considerably due to DMF assistance, but also because cities and towns recognize the value and importance of shellfisheries. Coastal cities and towns collectively spent $1,202,513 on shellfish management in 1984. However, several deficiencies exist in the present system. Funding for the reimbursement program has remained at the 1974 level, so local programs, expanded in response to state funding, have been slowly eroded as salaries, etc., increased. The expansion of local shellfish programs has greatly increased the need for technical assistance at the state level, and placed additional administrative burdens on DMF shellfish personnel. The need for technical assistance and administration of reimbursements cannot be met adequately by DMF under existing personnel and budget constraints. In addition, the greatly increased interest private shellfish aquaculture over the last decade and the resulting need for technical assistance, surveys, and licensing at the state and local levels has further worsened the problems created by level funding.

A final problem pertains to a need for more research and continued support of existing and proposed research. The aforementioned identification of pollution-related problems have originated primarily from research by the federal government and private firms. Apart from the emphasis on Boston Harbor and the Acushnet River estuary, research carried out by the Commonwealth traditionally has been scant. Hence, investigations to identify the existance and extent of problems in other areas of the Commonwealth's marine environment, identification of trends through monitoring, and major efforts to develop remedies or means to curtail this pollution have been minimal. Fortunately this situation is changing. More of these types of programs have been developed or proposed. The key need now is for continued and new support for these initiatives.

CONCLUSIONS

Efforts to address problems confronting Massachusetts' fisheries, the resources on which they depend, and the environment vital for the maintenance of these resources must be accelerated and not be allowed to abate. The major concern is that these problems are responsible for or eventually will result in great economic losses to the Commonwealth. For example:

---- Areas closed to shellfish harvest due to bacterial contamination along the Massachusetts coast cause an estimated annual economic loss of $12.1 million (landed value only). This is equal to 50% of the reported 1983 landed value of $24 million for the state's inshore shellfisheries. If economic multipliers are applied, total loss is $55 - $79 million.

---- Reduced landings of commercially important species equate to a loss of income to fishermen and processors and an adverse impact on the state's economy. Landings of haddock are approximately 25% of sustainable levels of 30,000-40,000 metric tons. This respresents an annual loss of about $50 million.

---- Catching and discarding small yellowtail flounder reduces yield to the fishery. In 1982, 10,300 metric tons of yellowtail were landed from New England waters. An additional 3,300 metric tons were discarded at sea because fish were too small[25]. If these fish had been allowed to reach a larger size before harvest, a minimum of $10 million potentially would have been realized at the producer level. Furthermore, large dollar losses occur each year due to the harvest of small winter flounder, sea scallops, and other species.

---- Seafood is an important part of the diet of Massachusetts' citizens and tourists. A public perception that seafood is hazardous can result in consumers seeking other alternatives. Restaurants and other seafood businesses will suffer. Additionally, tourists coming to fish in Massachusetts waters may make other choices as to how they spend their dollars and leisure time if they fear catching contaminated fish. Clearly, contaminated seafood or the presumption that seafood is contaminated can only be to the detriment of Massachusetts' economy if people decide not to eat seafood or choose to fish elsewhere.

Pollution, habitat loss, excessive fishing, the other described fisheries impediments, and bureaucratic shortcomings are major causes of this actual and potential economic loss. It is now up to the public, the Legislature, and state agencies, charged to protect the public's best long term interests, to reverse the course of our continued adverse impact on Massachusetts valuable commercial and recreational marine

fisheries, the resources on which they depend, and the habitats vital for sustenance of these resources.

Solutions will not come easily. Regarding concerns related to pollution, many of the problems and issues confronting fisheries and environmental agencies are complex, multifaceted, and require interdisciplinary approaches to resolution. Many problems are long-standing and chronic in nature and have developed over many decades. There are few "quick fix" solutions to these chronic problems. For example, many of the environmental sciences, engineering practices, and waste treatment technologies are still evolving and developing in the area of toxics control, dredge spoil disposal, and combined sewer overflow control. Many solutions to problems are not yet within reach. Furthermore, some of the known and proposed solutions (for example, dredging New Bedford Harbor to remove PCB's) are oftentimes complex, sometimes economically infeasible, and fraught with uncertainties.

Nevertheless, much can be done and is being done already. A spurring on of agencies is needed to accelerate their existing efforts and to develop new initiatives to meet the Commonwealth's commitment to a safe and well-balanced environment and a sound economic resource base. Public and legislative support is critical.

THE NEXT STEP

This White Paper is to be discussed at public meetings along the coast. The problems and issues raised herein will be expanded upon and other more specific local concerns will be incorporated. Following these meetings, recommendations for actions and remedial steps will be developed. An important component of this strategy will be effective communication and coordination with the Legislature.

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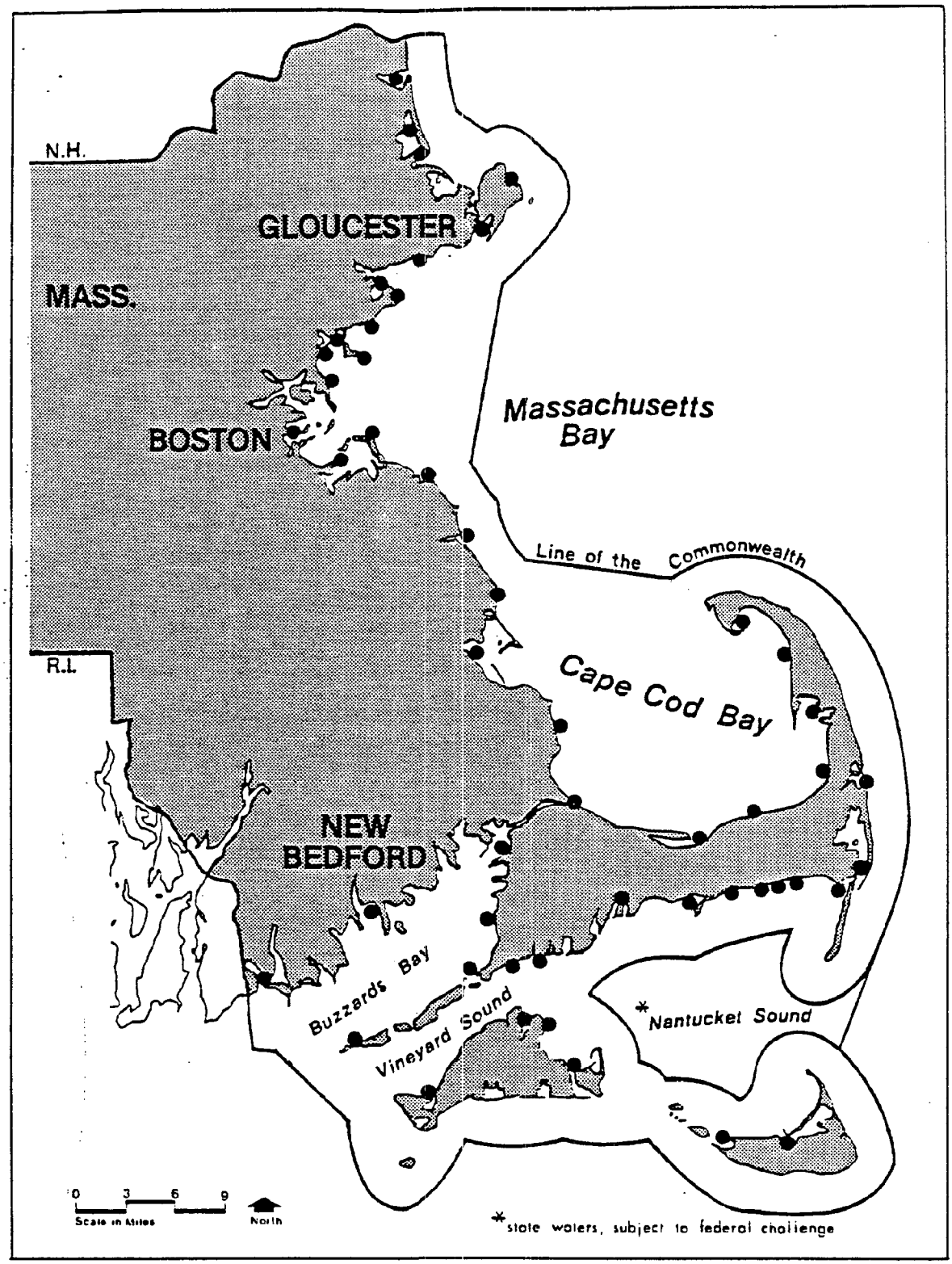


Figure 1. Massachusetts territorial waters and commercially important ports and harbors(●)

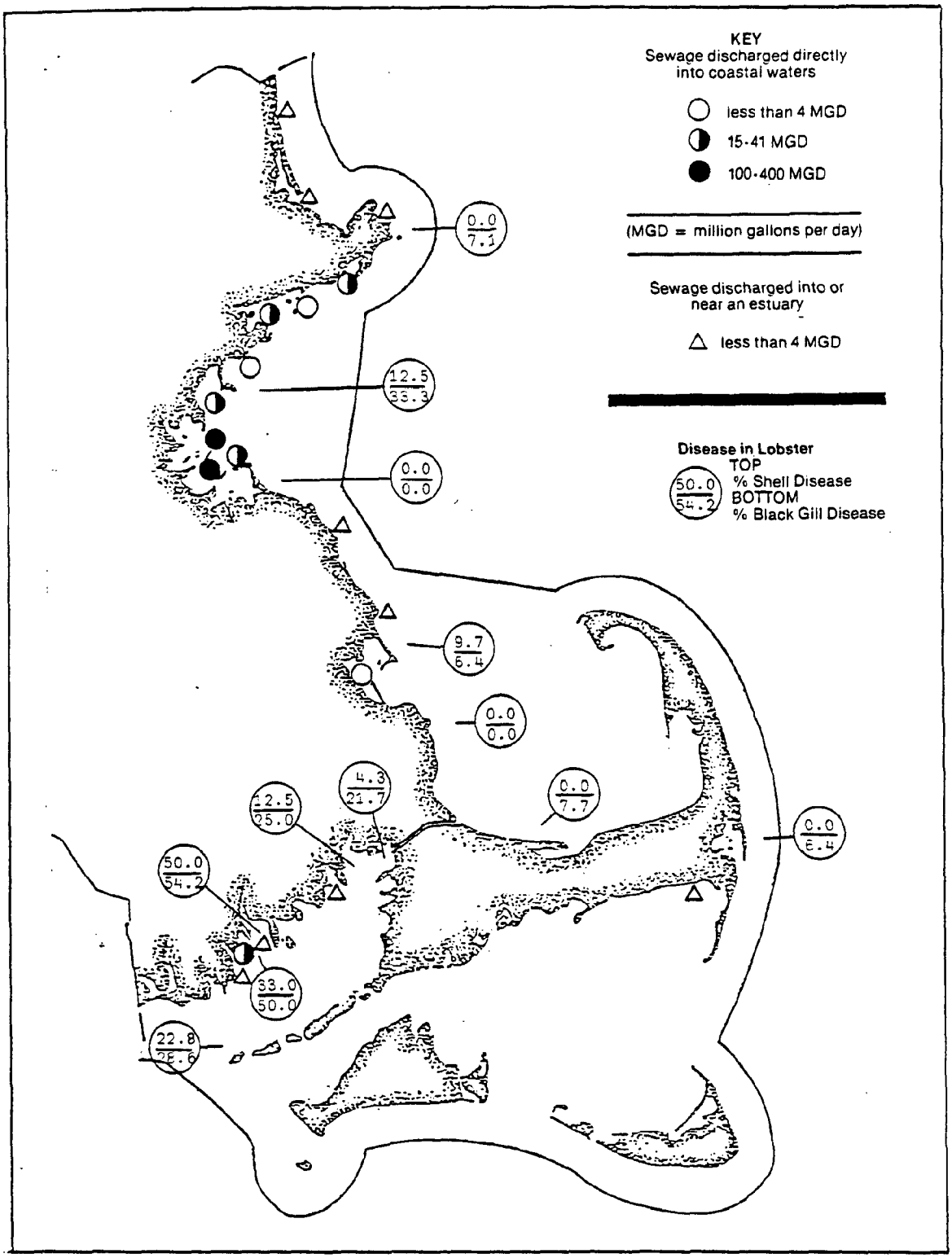


Figure 2. Percent incidence of two diseases in lobster - 1983 and 1984. Locations of major sewage outfalls.

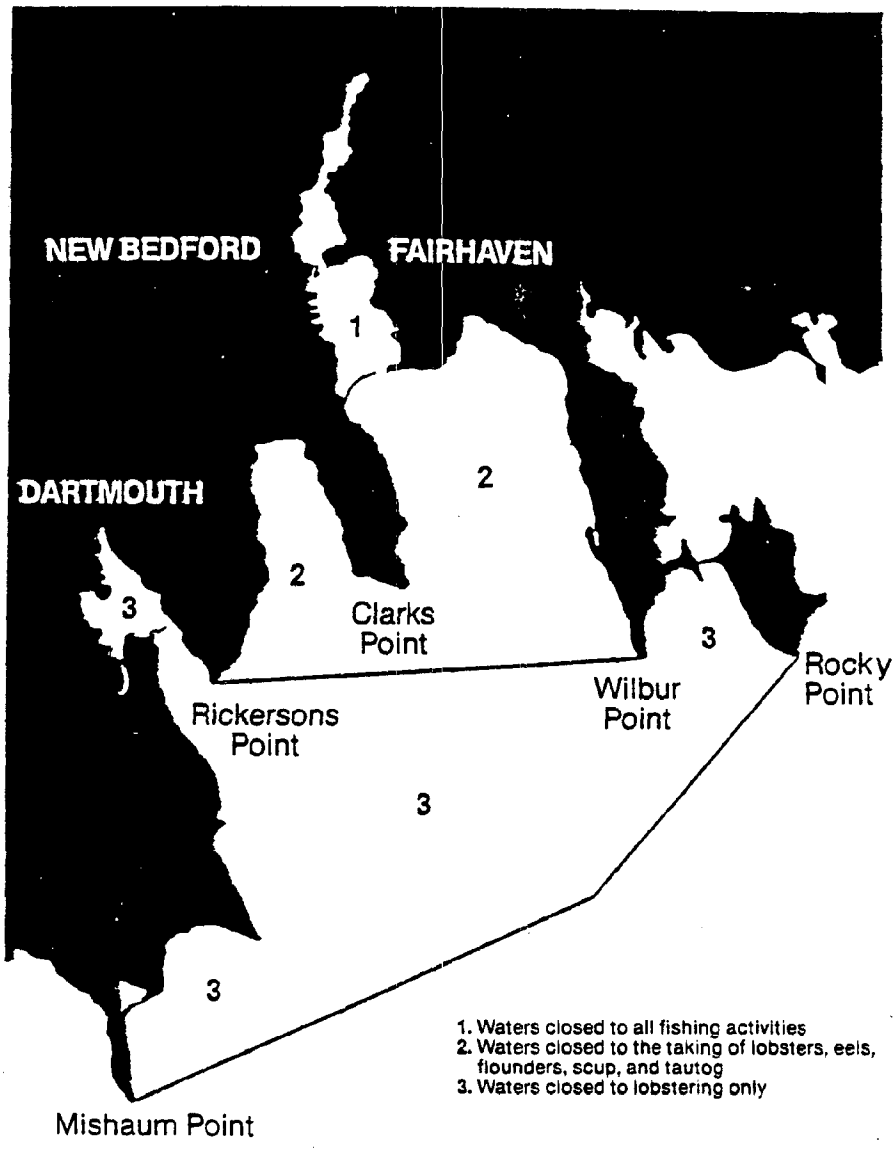


Figure 3. Areas subject to PCB closures.

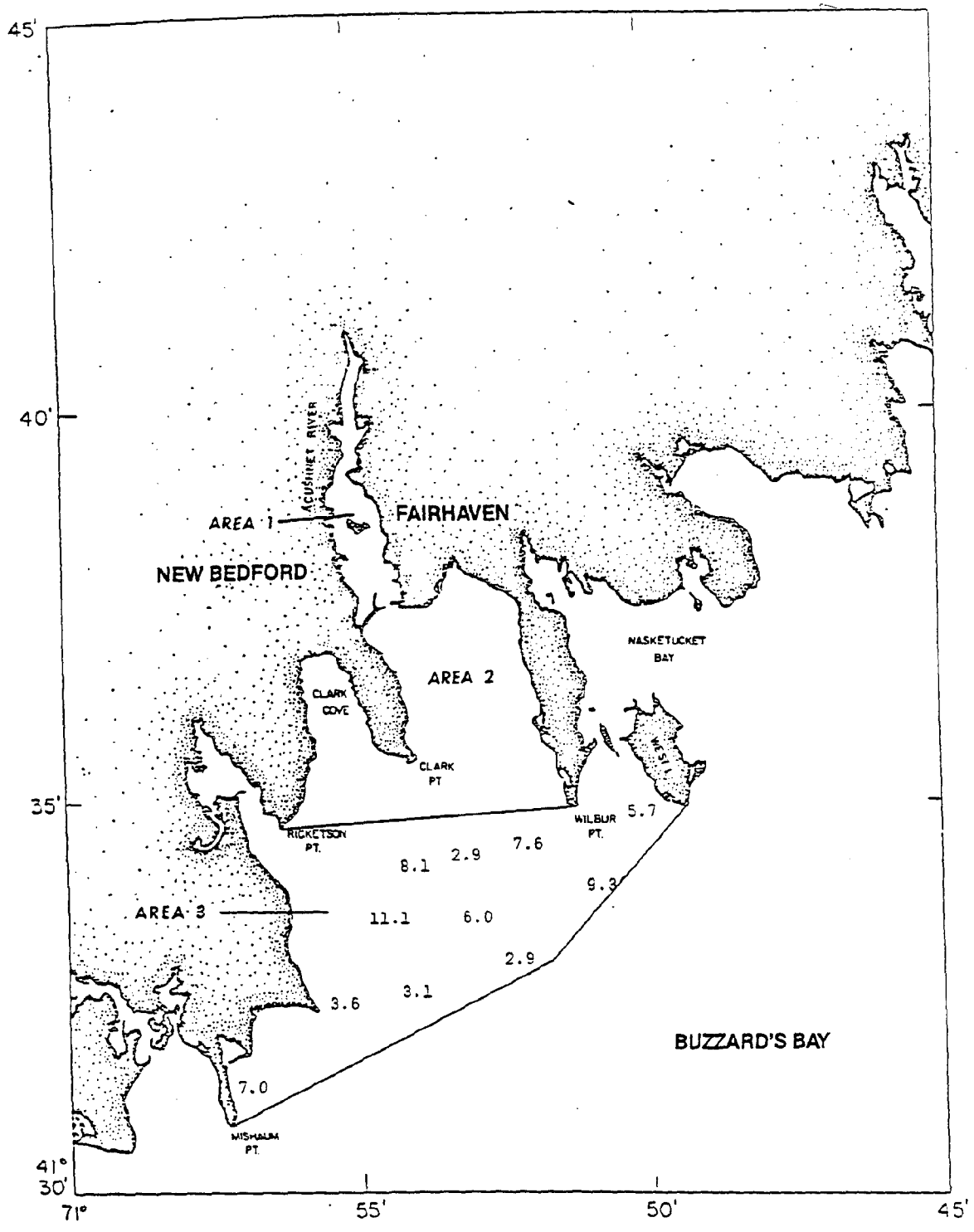
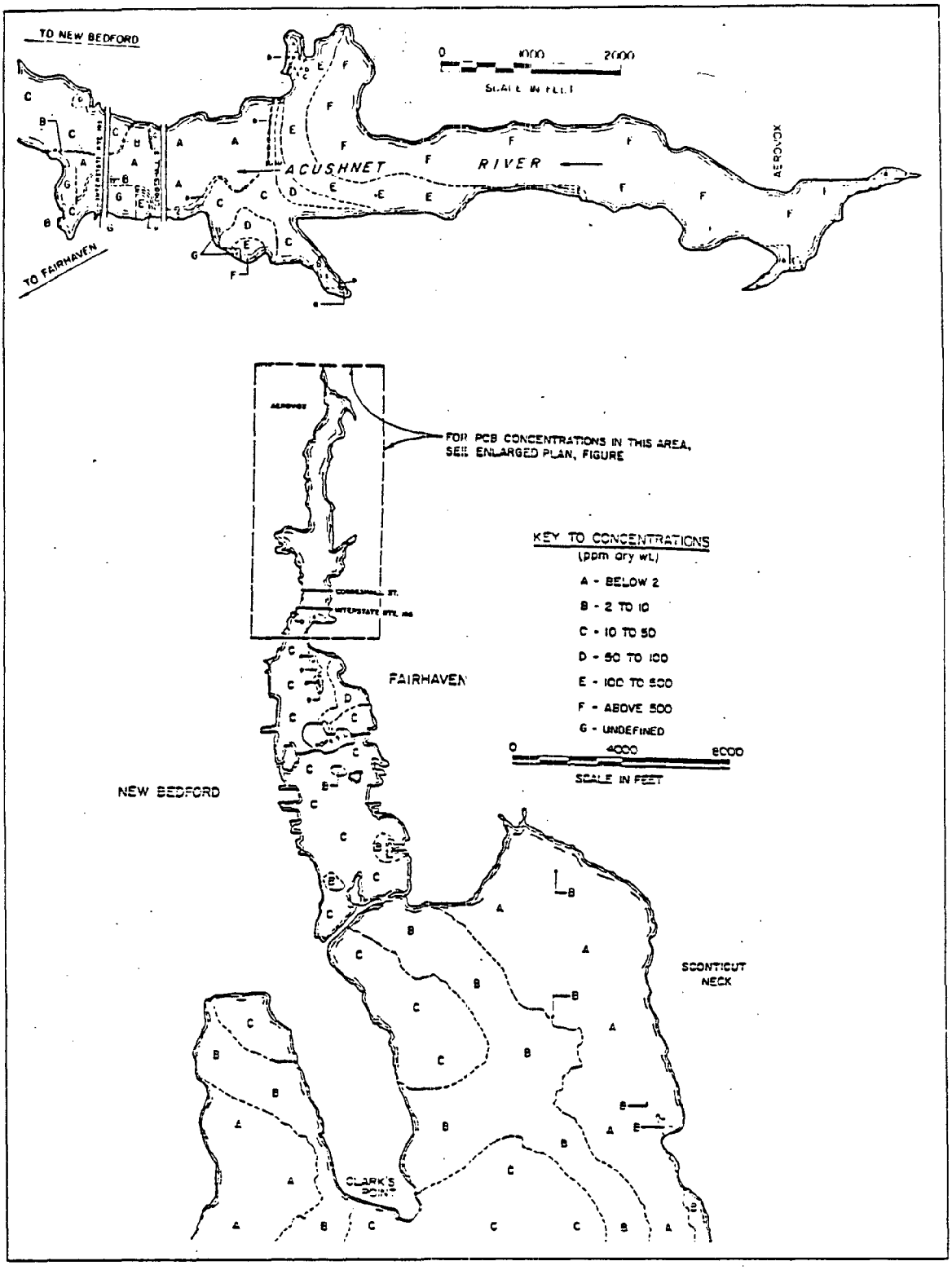


Figure 4. Spring 1984 PCB concentrations (ppm) at 11 sites in Area 3.



Source: NUS Corporation

Figure 5. Sediment PCB concentrations in Acushnet River estuary and New Bedford Harbor.

Status of North Shore & Boston Harbor
shellfish areas (productive) in 1984

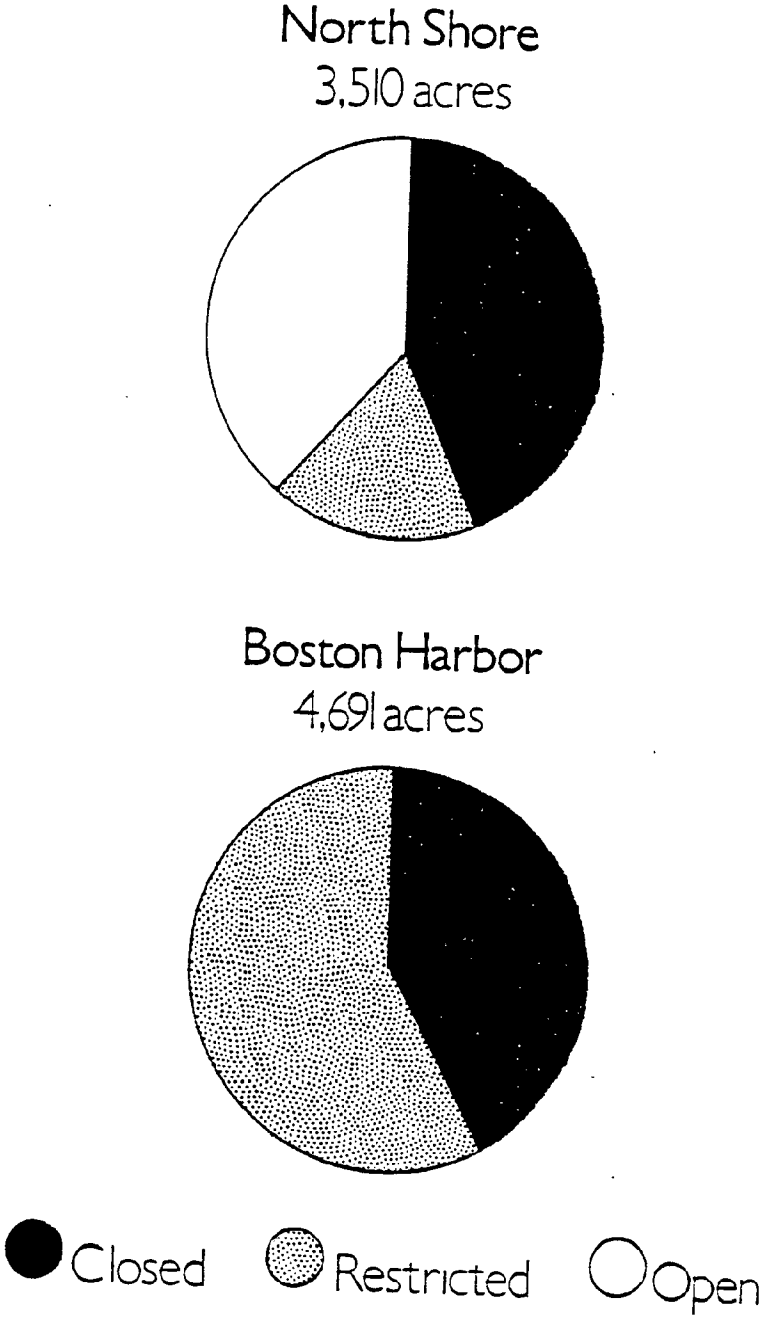
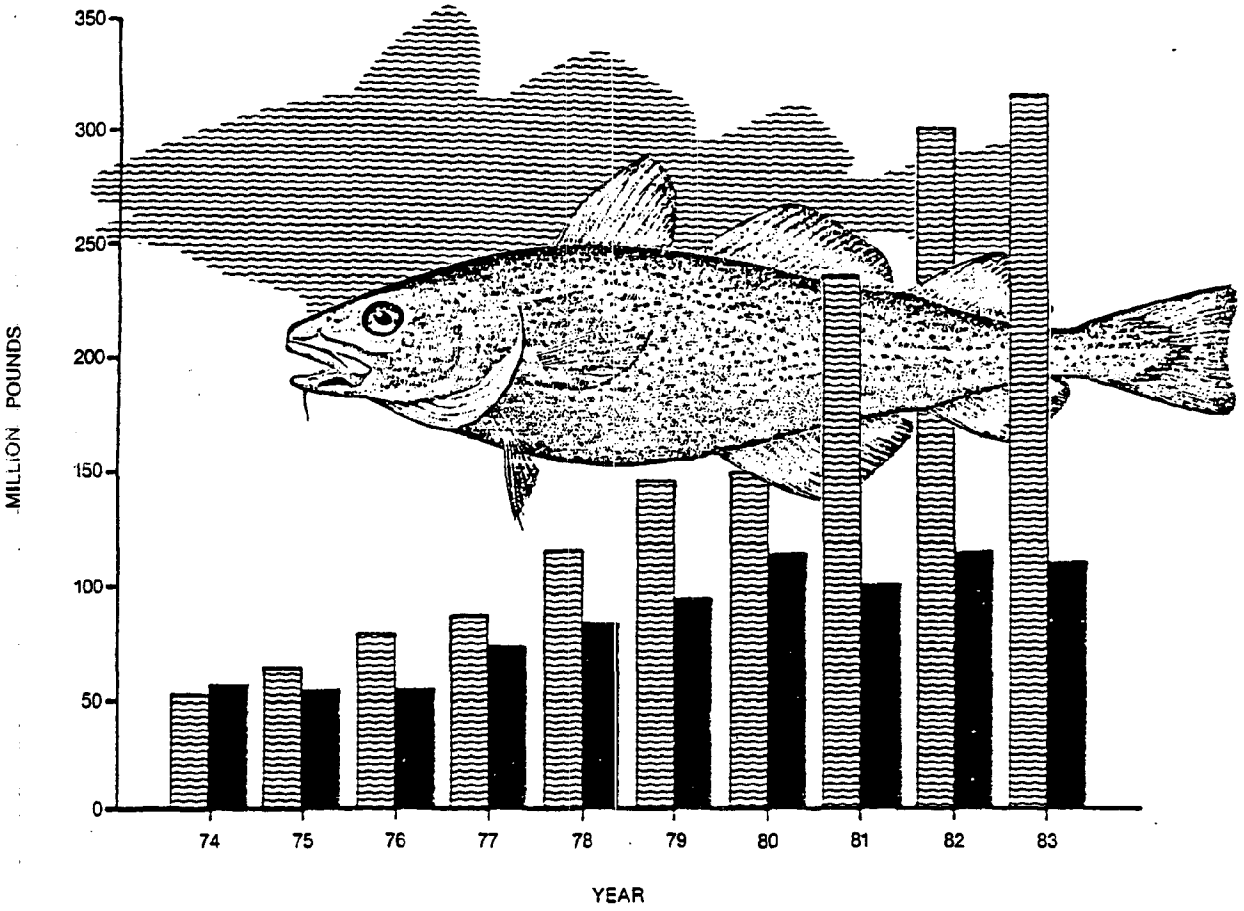


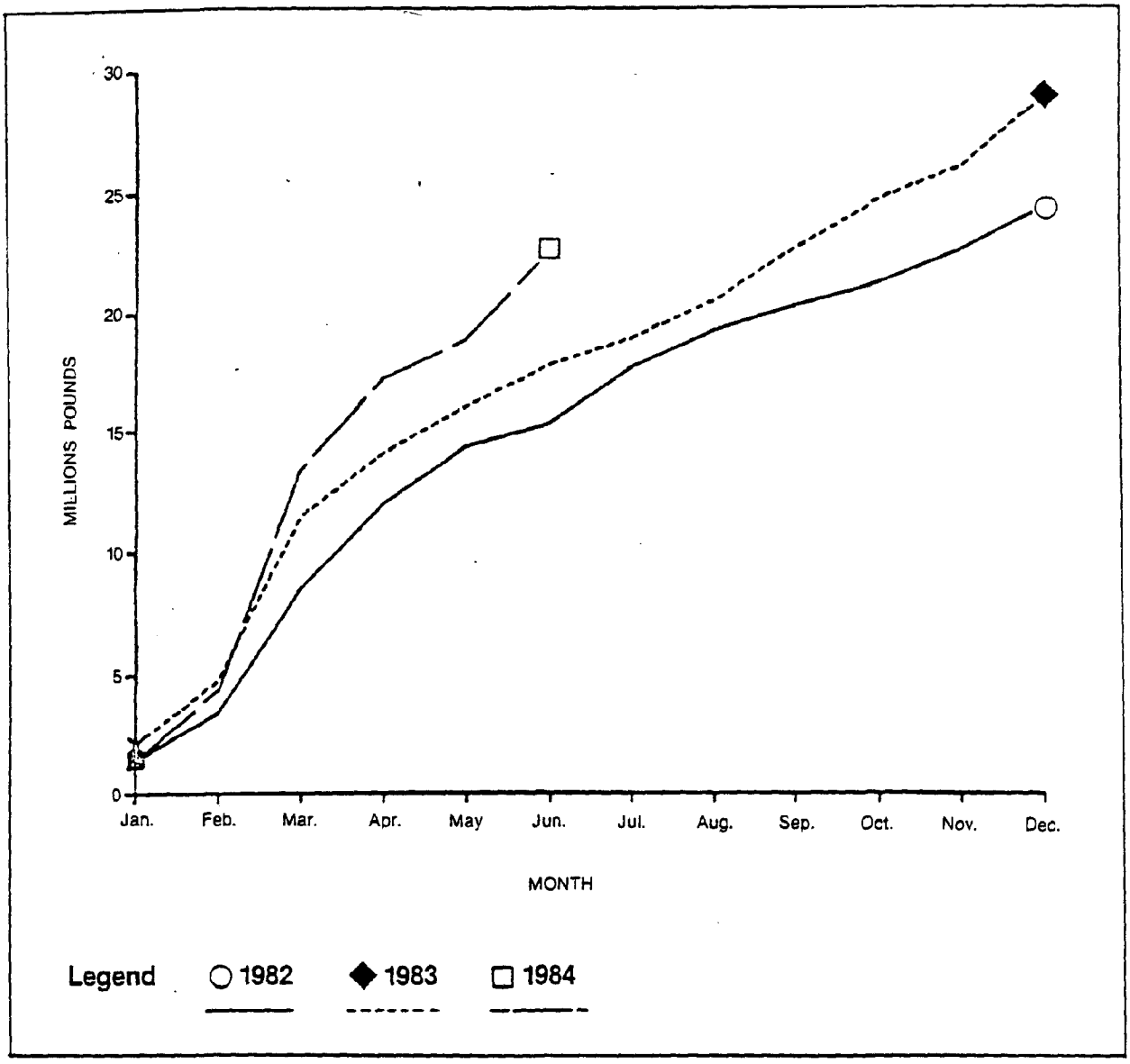
Figure 6.



Source: National Marine Fisheries Service

LEGEND IMPORTS LANDINGS

Figure 7. New England cod landings vs. U.S. imports from Canada 1974-1983 (live weight).



Source: National Marine Fisheries Service

Figure 8. Fresh cod fillets monthly cumulative New England imports from Canada 1982-1984.

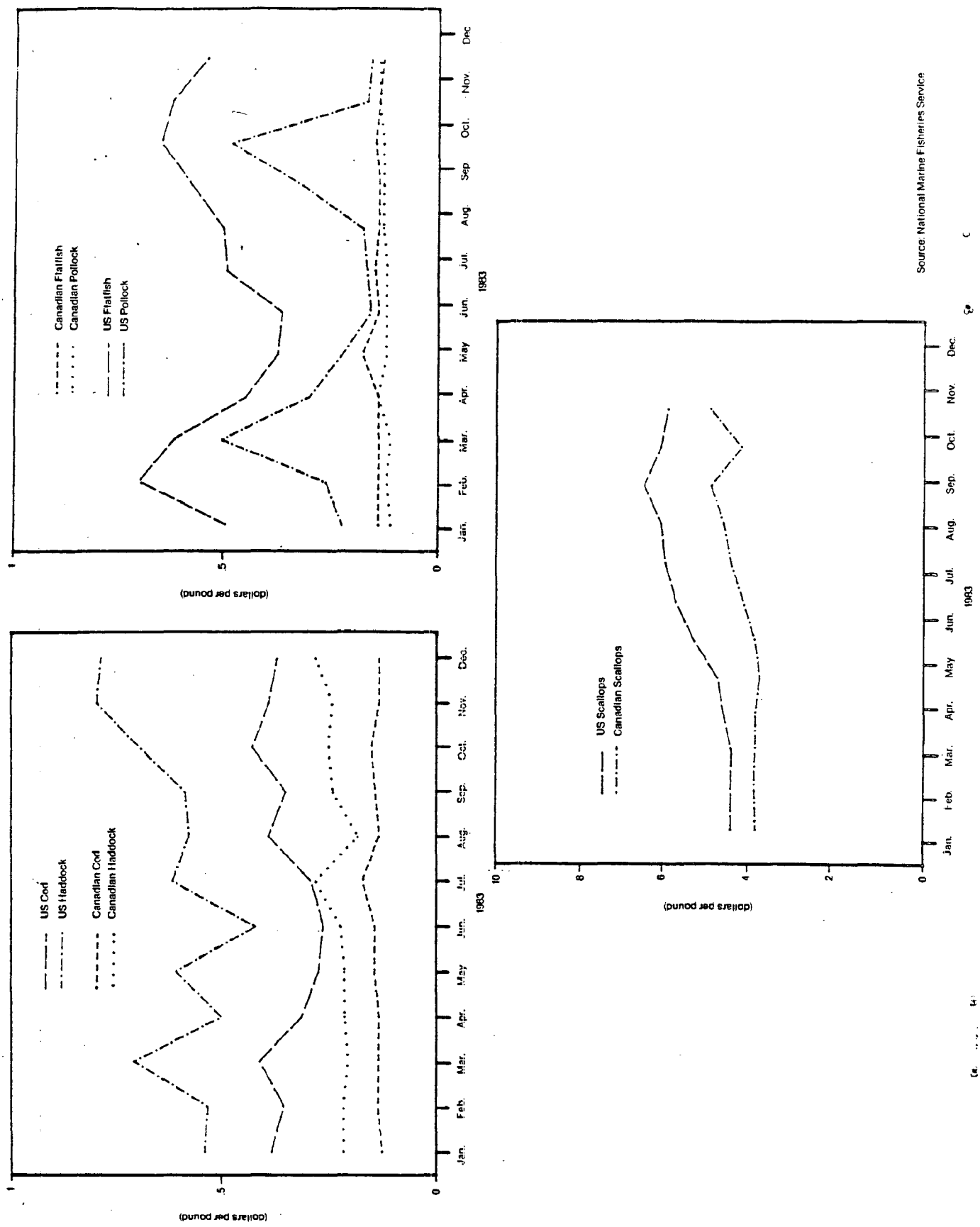


Figure 9. Average monthly Northeastern U.S. and Atlantic Canada ex-vessel prices for cod, haddock, flatfish, pollock, and sea scallops in 1983.

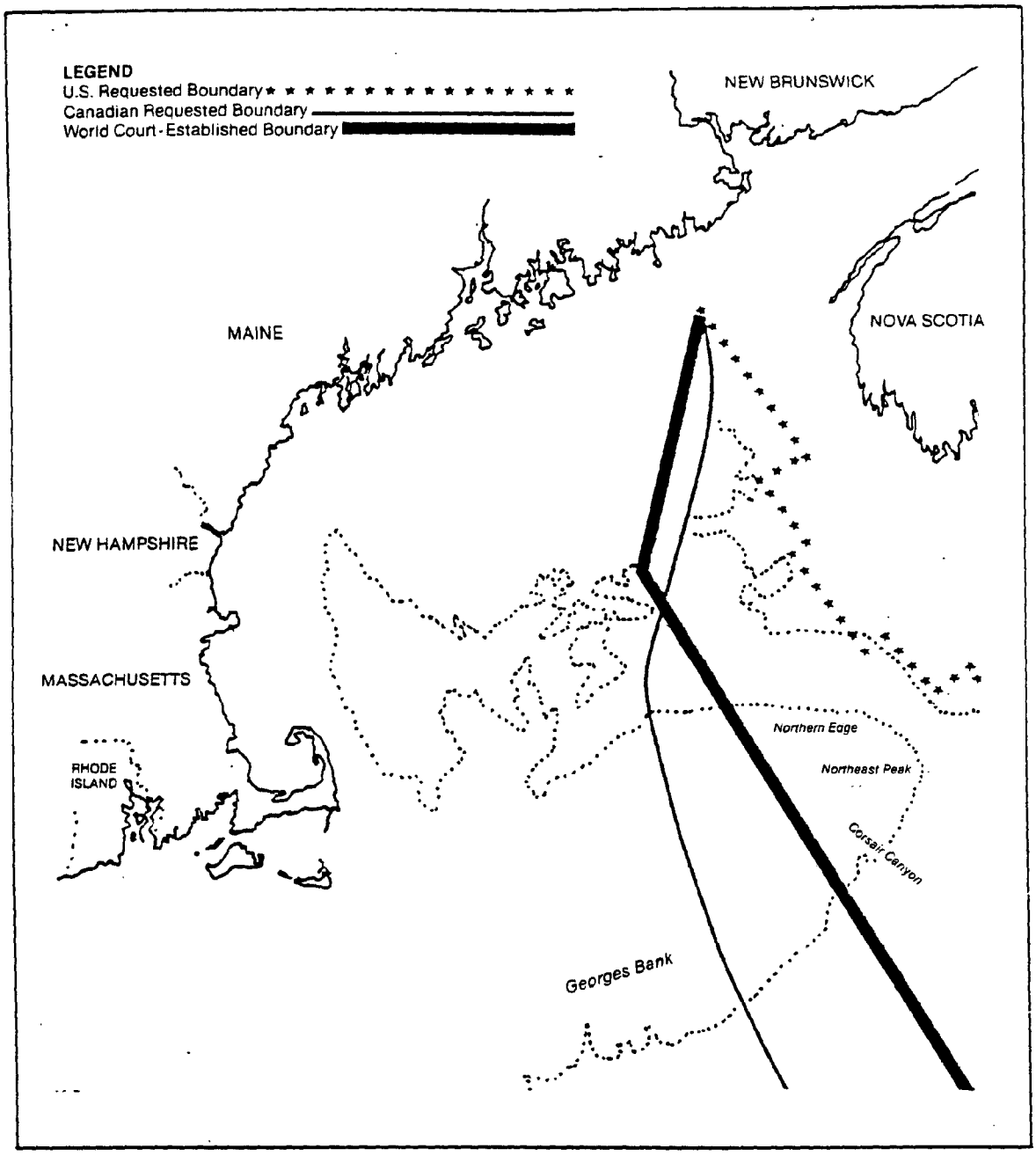


Figure 10. U.S./Canadian/World Court - Established Boundary.

Table 1. County acreage of three major natural resources.

	Barrier Beaches	Salt Marshes	Tidal Flats
Barnstable County	8,723.1	15,201.0	17,808.6
Bristol County	1,008.1	3,748.0	3,130.5
Dukes County	2,135.7	1,027.7	1,258.7
Essex County	2,955.4	18,026.9	6,087.7
Middlesex County	0.0	0.0	0.0
Nantucket County	1,841.7	657.3	136.9
Norfolk County	95.7	1,056.7	2,334.6
Plymouth County	1,933.8	7,400.0	9,369.9
Suffolk County	194.5	987.0	1,387.3
	18,880.0	48,104.6	41,514.2

Table 2. Major publically owned sewage treatment works discharging into open coastal or estuarine environments.

	Flow Rate (millions of gallons/day)
Boston, Deer Island	343
Boston, Nut Island	112
Chatham	0.44
Dartmouth	2.9
Fairhaven	2.07
Fall River	30.9
Hull	3.07
Gloucester	15.0
Ipswich	1.8
Lynn	25.8
Manchester	0.67
Marion	0.34
Marshfield	2.1
New Bedford	30.0
Newburyport	2.6
Plymouth	1.75
Rockport	0.8
Scituate	1.0
Somerset	1.6
South Essex	41.0
Swampscott	2.17
Taunton	8.4

Table 3.- Waters closed to shellfishing in 1984 by town and type of closure south of Boston Harbor (acreage)

	Sec. 74[a]	Sec. 74A[b]	Seasonal	Total
ISLANDS				
Chilmark	10.7	0	0	10.7
Edgartown	0	0	198.3	198.3
Gay Head	0	0	0	0
Gosnold	89.8	0	81.9	171.7
Nantucket	105.3	0	0	105.3
Oak Bluffs	0	6.0	48.2	48.2
Tisbury	0	0	82.7	82.7
West Tisbury		0	0	0
	205.8	6.0	411.1	616.9
CAPE COD				
Barnstable	125.7	160.2	0	285.9
Bourne	566.9	312.6	10.0	889.5
Brewster	12.8	0	0	12.8
Chatham	123.0	0	0	123.0
Dennis	0	0	0	0
Eastham	0	0	0	0
Falmouth	99.6	68.9	74.1	239.9
Harwich	55.8	20.5	0	76.3
Mashpee	72.6	0	0	72.6
Orleans	14.3	0	0	14.3
Provincetown	71.5	0	151.6	223.1
Sandwich	0	38.0	50.0	88.0
Truro	0	0	0	0
Wellfleet	20.0	0	50.1	70.1
Yarmouth	7.0	0	0	7.0
	1,169.2	600.2	333.1	2,102.5

	Sec. 74	Sec. 74A	Seasonal	Total
BUZZARDS BAY				
Acushnet	58.6	0	0	58.6
Berkley	586.2	0	0	586.2
Dartmouth	1,631.7	0	0	1,631.7
Dighton	210.2	0	0	210.2
Fairhaven	2,611.2	0	0	2,611.2
Fall River	955.4	0	0	955.4
Freetown	2,389.1	0	0	2,389.1
Marion	0	13.1	175.9	189.0
Mattapoisett	75.1	53.5	0	128.6
New Bedford	4,168.2	0	0	4,168.2
Somerset	2,339.8	0	0	2,339.8
Swansea	864.9	43.7	0	908.6
Wareham	74.4	0	0	74.4
Westport	994.8	0	0	994.8
	16,959.6	110.3	175.9	17,254.8
CANAL NORTH				
Cohasset	88.4	60.1	0	148.5
Duxbury	362.5	20.0	0	382.5
Kingston	167.3	0	0	167.3
Marshfield	1,196.8	401.8	0	1,598.6
Plymouth	2,009.6	75.8	0	2,085.4
Scituate	546.3	497.6	0	1,043.9
	4,370.9	1,055.3	0	5,426.2

[a] Chapter 130 M.G.L. - Determination of contaminated areas; duties of Department of Public Health prior to determination

[b] Chapter 130 M.G.L. - Power to designate shellfish areas as contaminated in event of emergency; report; notice to local authorities

Table 4. Waters closed to shellfishing by region (acres).

	Sec 74[a]	Sec 74A[b]	Seasonal	Total
		Martha's Vineyard Nantucket		
1980	174.3	6.0	436.6	616.9
1982	69.0	2,633.8	436.6	3,139.4
1984	205.8	6.0	411.1	616.9
		Cape Cod		
1980	391.5	189.4	131.4	712.3
1982	572.1	157.3	181.5	910.9
1984	1,169.2	600.2	333.1	2,102.5
		Buzzards Bay		
1980	14,614.9	598.1	27.2	15,240.2
1982	3,365.0	11,479.8	27.2	14,872.0
1984	16,959.6	110.3	175.9	17,245.8
		Cape Cod Canal North		
1980	3,180.6	140.9	0	3,321.5
1982	2,805.1	201.0	0	3,006.1
1984	4,370.9	1,055.3	0	5,426.2
		Totals		
1980	18,361.3	934.4	595.2	19,890.9
1982	6,811.2	14,471.9	645.3	21,928.4
1984	22,705.5	1,771.8	920.1	25,397.4

[a] Chapter 130 M.G.L. - Determination of contaminated areas; duties of Department of Public Health prior to determination

[b] Chapter 130, M.G.L. - Power to designate shellfish areas as contaminated in event of emergency; report; notice to local authorities

Table 5. Status of productive shellfish areas in 1984 (acres)

NORTH SHORE

	Productive	Open	Closed	Restricted
Salisbury	208.4	0	208.4	0
Newburyport	524.8	0	447.7	77.1
Newbury	253.8	139.1	109.6	5.1
Rowley	47.7	47.7	0	0
Ipswich	633.9	453.6	0	180.3
Essex	340.7	340.7	0	0
Gloucester	608.2	442.8	37.7	127.7
Manchester	16.7	0	16.7	0
Beverly	67.8	0	67.8	0
Danvers	98.9	0	98.9	0
Salem	218.3	0	181.2	37.1
Marblehead	54.9	0	0.3	54.6
Nahant	42.5	0	42.5	0
Lynn	98.3	0	98.3	0
Saugus	123.1	0	123.1	0
Revere	176.0	0	143.6	32.4
	3,514.0	1,423.9	1,575.8	514.3

BOSTON HARBOR

	Productive	Open	Closed	Restricted
Boston	1,353.0	0	1,001.9	351.1
Milton	59.3	0	59.3	0
Quincy	1,238.0	0	551.2	686.8
Hull	356.0	0	22.1	333.9
Braintree	42.0	0	0	42.0
Weymouth	380.9	0	54.9	326.0
Hingham	344.6	0	12.0	332.6
Winthrop	916.7	0	125.1	791.6
	4,690.5	0	1,826.4	2,864.0
Total		1,423.9	3,402.3	3,378.3
Grand Total			6,780.6	