Chesapeake Executive Council

Chesapeake Bay Bluefish Fishery Management Plan

Chesapeake Bay Program

Agreement Commitment Report

December 1990

Printed on Recycled Paper

Chesapeake Bay Bluefish Fishery Management Plan

An Agreement Commitment Report from
the Chesapeake Executive Council

Annapolis, Maryland
December 1990

Printed by the United States Environmental Protection Agency
for the
Chesapeake Bay Program

ADOPTION STATEMENT

The Chesapeake Bay Bluefish Management Plan has been prepared for the Chesapeake Bay Program and adopted by the Chesapeake Executive Council.

Chesapeake Executive Council:

Lawrence Douglas Wilder

Commonwealth of Virginia

William Donald Schaefer

State of Maryland

Robert P. Casey

Commonwealth of Pennsylvania

William K. Reilly

United States of America

Sharon Pratt Dixon

District of Columbia

W. Tayloe Murphy

Chesapeake Bay Commission

TABLE OF CONTENTS

Figures

ACKNOWLEDGEMENTS

The Chesapeake Bay Bluefish Management Plan was developed under the direction of the Fisheries Management Workgroup. Staff from the Maryland Department of Natural Resources (MDNR), Tidewater Administration, Fisheries Division were responsible for writing the plan and addressing comments on the draft versions. Support was provided by staff from the Virginia Marine Resources Commission (VMRC), Fisheries Management Division. Contributing MDNR staff included Nancy Butowski, Phil Jones, Randy Schneider, and Harley Speir. VMRC staff included Erik Barth, Lewis Gillingham, and Roy Insley. Thanks are due to Verna Harrison and Ed Christoffers for guiding the plan through the development and adoption process. Dave Packer, from EPA's Chesapeake Bay Liaison Office, assisted with production and distribution. Finally, we express gratitude to members of other Chesapeake Bay Program committees and workgroups and to the public who commented on the plan.

Members of the Fisheries Management Workgroup were:

Mr. Mark Bundy, STAC Economic Advisory Group
Mr. K.A. Carpenter, Potomac River Fisheries Commission
Mr. Ira Palmer, D.C. Department of Consumer & Regulatory Affairs
Mr. William Goldsborough, Chesapeake Bay Foundation
Mr. J. W. Gunther, Jr., Virginia Waterman
Mr. Robert Hesser, Pennsylvania Fish Commission
Dr. Michael Hirshfield, MD Department of Natural Resources
Dr. Edward Houde, UMCEES/Chesapeake Biological Laboratory
Mr. W. Pete Jensen, Chair, MD Department of Natural Resources
Mr. J. Claiborne Jones, Chesapeake Bay Commission
Dr. Robert Lippson, NOAA/National Marine Fisheries Service
Dr. Joseph G. Loesch, Virginia Institute of Marine Science
Dr. Charles F. Lovell, Jr., M.D., Virginia
Mr. Richard Novotny, Maryland Saltwater Sportfishermen's Assoc.
Mr. Ed O'Brien, MD Charter Boat Association
Mr. James W. Sheffield, Atlantic Coast Conservation Assoc. of Va.
Mr. Larry Simns, MD Watermen's Association
Mr. Jack Travelstead, Virginia Marine Resources Commission
Ms. Mary Roe Walkup, Citizen's Advisory Committee

EXECUTIVE SUMMARY

Introduction

One of the strategies for implementing the Living Resources Commitments of the 1987 Chesapeake Bay Agreement is to develop and adopt a series of baywide fishery management plans (FMPs) for commercially, recreationally, and selected ecologically valuable species. The FMPs are to be implemented by the Commonwealth of Pennsylvania, Commonwealth of Virginia, District of Columbia, Potomac River Fisheries Commission, and State of Maryland as appropriate. Under a timetable adopted for completing management plans for several important species, the bluefish FMP was scheduled for completion in December 1990.

A comprehensive approach to managing Chesapeake Bay fisheries is needed because biological, physical, economic, and social aspects of the fisheries are shared among the Bay's jurisdictions. The Chesapeake Bay Program's Living Resources Subcommittee formed a Fisheries Management Workgroup to address the commitment in the Bay Agreement for comprehensive, baywide fishery management plans. The workgroup is composed of members from government agencies, the academic community, the fishing industry, and public interest groups representing Pennsylvania, Maryland, Virginia, the District of Columbia, and the federal government.

Development of Fishery Management Plans

An FMP prepared under the 1987 Chesapeake Bay Agreement serves as a framework for conserving and wisely using a fishery resource of the Bay. Each management plan contains a summary of the fishery under consideration, a discussion of problems and issues that have arisen, and recommended management actions. An implementation plan is included at the end of the FMP to provide additional details on the actions that participating jurisdictions will take and the mechanisms for taking these actions.

Development of a fishery management plan is a dynamic process. The process starts with initial input by the Fishery Management Workgroup, is followed by public and scientific review of the management proposals, and then by endorsement by the appropriate Chesapeake Bay Program committees. A management plan is adopted when it is signed by the Chesapeake Bay Program's Executive Committee. In some cases, regulatory and legislative action will have to be initiated, while in others, additional funding and staffing may be required to fully implement a management action. A periodic review of each FMP will be conducted under the auspices of the Bay Program's Living Resources Subcommittee, to incorporate new information and to update management strategies as needed.

Goal of the Bluefish Management Plan

The goal of the Chesapeake Bay Bluefish Management Plan is to protect and monitor the bluefish resource in the Chesapeake Bay, its tributaries, and state coastal waters, to provide for optimum long-term ecological, economic, and social benefits.

In order to meet this goal, a number of objectives must be met. They include following the guidelines established by the Atlantic States Marine Fisheries Commission (ASMFC) and the Mid-Atlantic Fishery Management Commission (MAFMC) for coastwide management of the bluefish fishery, providing for fair allocation of the resource, promoting efficient harvesting practices, promoting biological and economic research, and pursuing standards of environmental quality and habitat protection. These objectives are incorporated into the problem areas and management strategies discussed below.

Problem Areas and Management Strategies

Problem 1: Stock Status and Increased Fishing Pressure. Commercial and recreational bluefish harvests are currently at high levels. The commercial market demand and price are presently unstable, yet the fishery has the potential to expand. Recreational harvest accounts for 85% - 90% of the total catch and the number of sport fishermen is increasing. Historically, bluefish abundance appears to have been highly variable; therefore, there is always the possibility of an unpredictable, natural decrease. Recent stock analysis indicates the bluefish population along the Atlantic coast is being fully exploited.

Strategy 1: In order to protect the bluefish resource in the Chesapeake Bay and along the Atlantic coast from overexploitation, the Bay jurisdictions will work with the MAFMC and ASMFC to coordinate research and management. In addition, the Bay jurisdictions will monitor the bluefish fisheries and implement conservative management measures as needed. Management measures include: establishing commercial harvest controls if the harvest is projected to equal or exceed 20% of the total bluefish catch from the Atlantic coast; fully implementing licensing requirements for the commercial harvest and sale of bluefish; and establishing a 10 fish per person per day recreational creel limit which may be modified as needed.

Problem 2: Wasteful Harvest Practices. Both the recreational and commercial fisheries have wasted some of their bluefish harvest. Unmarketable bluefish from the commercial fishery have been discarded in the Bay and recreational fishermen have discarded excess bluefish that have been caught by hook and line.

Strategy 2: Efforts will be made to reduce the discard of dead bluefish in the Chesapeake Bay. A daily creel limit will reduce wastage in the recreational fishery. The jurisdictions will also educate the general public, through the use of informational brochures and other means, about the need to reduce wastage in the fishery. The jurisdictions will begin identifying and assessing the factors that contribute to wastage in the commercial fishery and take necessary action.

Problem 3: Research and Monitoring Needs. There is a lack of information regarding population dynamics of bluefish in the Chesapeake Bay, including what factors affect their occurrence, distribution, and abundance. Adequate information on the bluefish fisheries is also lacking. In order to monitor stock levels and improve management, additional data on bluefish biology, market demands, and catch and effort is needed.

Strategy 3: Chesapeake Bay jurisdictions will make efforts to improve the understanding of the Bay's recreational and commercial fisheries. They will also encourage research to collect additional data on bluefish biology. Among the recommendations are to improve reporting and analysis of catch information, collect additional data on the composition of the bluefish catch, and conduct studies on the effects of environmental parameters on bluefish populations.

Problem 4: Habitat and Water Quality Issues. Water quality impacts the distribution, abundance, and quality of finfish species in the Chesapeake Bay. Habitat destruction also contributes to the reduction of finfish abundance. Low oxygen levels are known to limit bluefish movement and toxic contamination of bluefish is an important issue.

Strategy 4: The Bay jurisdictions will continue their efforts to improve water quality and define habitat requirements for the living resources in the Chesapeake Bay pursuant to the 1987 Chesapeake Bay Agreement. Efforts include identifying and controlling nutrients, toxic materials, conventional pollutants, and atmospheric inputs, and protecting wetlands and submerged aquatic vegetation.

INTRODUCTION

MANAGEMENT PLAN BACKGROUND

As part of the 1987 Chesapeake Bay Agreement's commitment to protect and manage the natural resources of the Chesapeake Bay, the Bay jurisdictions are developing a series of fishery management plans covering commercially, recreationally, and selected ecologically valuable species. Under the agreement's Schedule for Developing Baywide Resource Management Strategies, a list of priority species was formulated, with a timetable for completing fishery management plans as follows:

- oysters, blue crabs and American shad by July 1989;
- striped bass, bluefish, weakfish and spotted seatrout by 1990;
- croaker, spot, summer flounder and American eel by 1991; and
- red and black drum by 1992

A comprehensive and coordinated approach by the various local, state and federal groups in the Chesapeake Bay watershed is central to successful fishery management. Bay fisheries are traditionally managed separately by Pennsylvania, Maryland, Virginia, the District of Columbia, and the Potomac River Fisheries Commission. There is also a federal Mid-Atlantic Fishery Management Council, which has management jurisdiction for offshore fisheries (3-200 miles), and a coast-wide organization, the Atlantic States Marine Fisheries Commission (ASMFC), which coordinates the management of migratory species in state waters (internal waters to 3 miles offshore) from Maine to Florida. The state/federal Chesapeake Bay Stock Assessment Committee (CBSAC) is responsible for developing a Baywide Stock Assessment Plan, which includes collection and analysis of fisheries information, but does not include the development of fishery management plans.

Consequently, a Fisheries Management Workgroup, under the auspices of the Chesapeake Bay Program's Living Resources Subcommittee, was formed to address the commitment in the Bay Agreement for Baywide fishery management plans. The Fisheries Management Workgroup is responsible for developing fishery management plans with a broad-based view. The workgroup's members represent fishery management agencies from Maryland, Pennsylvania, Virginia, the District of Columbia, and the federal government; the Potomac River Fisheries Commission; the Bay area academic community; the fishing industry; conservation groups; and interested citizens. Establishing Chesapeake Bay FMPs, in addition to coastal FMPs, creates a forum to specifically address problems that are unique to the Chesapeake Bay. They also serve as the basis for implementing regulations in the Bay jurisdictions.

WHAT IS A FISHERY MANAGEMENT PLAN?

A Chesapeake Bay fishery management plan provides a framework for the Bay jurisdictions to take compatible, coordinated management measures to conserve and utilize a fishery resource. A management plan includes pertinent background information, lists management actions that need to be taken, the jurisdictions responsible for implementation, and an implementation timetable.

A fishery management plan is not an endpoint in the management of a fishery; rather, it is part of a dynamic, ongoing process consisting of several steps. The first step consists of analyzing the complex biological, economic and social aspects of a particular finfish or shellfish fishery. The second step includes defining a fishery's problems, identifying potential solutions, and choosing appropriate management strategies. Next, the chosen management strategies are put into action or implemented. Finally, a plan must be regularly reviewed and updated in order to respond to the most current information on the fishery; this requires that a management plan be adaptive and flexible.

GOALS AND OBJECTIVES FOR FISHERY MANAGEMENT PLANS

The goal of fisheries management is to protect the reproductive capability of the resource while providing for its optimal use by man. Fisheries management must include biological, economic and social considerations in order to be effective. Three simply stated objectives to achieve this goal are:

- quantify biologically appropriate levels of harvest;
- monitor current and future resource status to ensure harvest levels are conserving the species while maintaining an economically viable fishery; and
- adjust resource use and other factors affecting resource status, as needed, through management efforts.

These general objectives are incorporated with information on a particular resource and the current status of management for that resource, into specific objectives for a fishery management plan.

MANAGEMENT PLAN FORMAT

The background section of this management plan summarizes:

- natural history and biological profile of bluefish;
- bluefish fishery and fishery parameters;

- economic perspective;
- resource status;
- habitat issues;
- FMP status and management unit;
- coastal management measures;
- Current laws and regulations in the Chesapeake Bay; and
- data and analytical needs.

The background information is derived primarily from the document entitled, Chesapeake Bay Fisheries: Status, Trends, Priorities and Data Needs and is supplemented with additional data. Inclusion of this section as part of the management plan provides historical background and basic biological information for each of the species.

The management section of the plan, which follows the background, defines:

- the goal and objectives for management of the species;
- problem areas;
- management strategies to address each problem area; and
- action items, with a schedule for implementation, by the appropriate management agency.

THE CHESAPEAKE BAY PROGRAM'S FISHERY MANAGEMENT PLANNING PROCESS

The planning process starts with initial input by the Fisheries Management Workgroup and development of a draft plan. This is followed by a review of the management proposals by Bay Program committees, other scientists and resource managers, and the public. After a revised draft management plan is prepared, it must be endorsed by the Chesapeake Bay Program's Living Resources Subcommittee and Implementation and Principal Staff committees. The plan is then sent to the Executive Committee for adoption.

Upon adoption, the appropriate management agencies implement the plan. In some cases, regulatory and legislative action must be initiated, and additional funding and staffing may be required. A periodic review of each FMP is conducted by the Fisheries Management Workgroup to incorporate new information and to update management strategies as needed.

Section 1. Bluefish Background

Life History

Bluefish (Pomatomus saltatrix) is the only member of the family, Pomatomidae, and is closely related to the jacks, pompanos, and roosterfish (Bigelow and Schroeder 1953). Bluefish are also commonly known as blue, tailor, snapper, elf, fatback, snapping mackerel, skipjack, horse mackerel, greenfish, chopper and Hatteras blue (Wilk 1977). Bluefish have a world-wide distribution with occurrences recorded in the Atlantic Ocean, the Mediterranean Sea, the Black Sea, and the Indian Ocean. Along the east coast of the United States, bluefish can be found from Nova Scotia to Texas. Lund (1961) identified stocks of bluefish along the Atlantic coast based on meristic characteristics and Wilk (1977) concluded that during the spawning season, one stock could be distinguished in the Middle Atlantic Bight and another stock could be distinguished off the coast of North Carolina (Figure 1). Early life history studies by Kendall and Walford (1979) found two geographically distinct concentrations of larvae, one shoreward of the Gulf Stream from Florida to Cape Hatteras (South Atlantic Bight) and the other in shelf waters from Cape Hatteras to Cape Cod (Middle Atlantic Bight). Austin and Graves (1990) have shown that a single genetic stock exists in the mid-Atlantic, and that the "two stocks" reported by Wilk (1977) are environmentally induced morphotypes. This means that the north and south spawned fish can be separated based upon morphological characters, even though they are of a single genetic stock. The Mid-Atlantic Management Council (MAFMC) and the Atlantic States Marine Fisheries Commission's (ASMFC) fishery management plan for bluefish along the Atlantic coast, therefore, treats the species as a single unit stock.

Bluefish typically inhabit the continental shelf waters of warm temperate zones. They undertake extensive coastal migrations and generally travel in like-sized groups of fish. Results from controlled laboratory experiments suggest migration is affected by temperature and photoperiod (Olla and Studholme 1971, 1972). With increasing water temperature and day length, bluefish migrate northward. They appear to follow warmer water with local movements into and out of bays and sounds affected by changes in tide, weather, season, and food supply. Fall migration takes place when the water temperature begins to decline (Lund and Maltezos 1970). Although this is the generally accepted description of bluefish migration, movement patterns are complex and not well understood. Younger fish appear to follow different migratory routes than older fish. In addition, the Middle Atlantic Bight population and the South Atlantic Bight population appear to have different migration patterns. An analysis of bluefish distribution suggests they are limited by the 9°C (48.2°F) to the 30°C (86°F) isotherms (Wilk 1977), therefore, cold cells and frontal systems may act as barriers to bluefish migration (Olla et al. 1985).

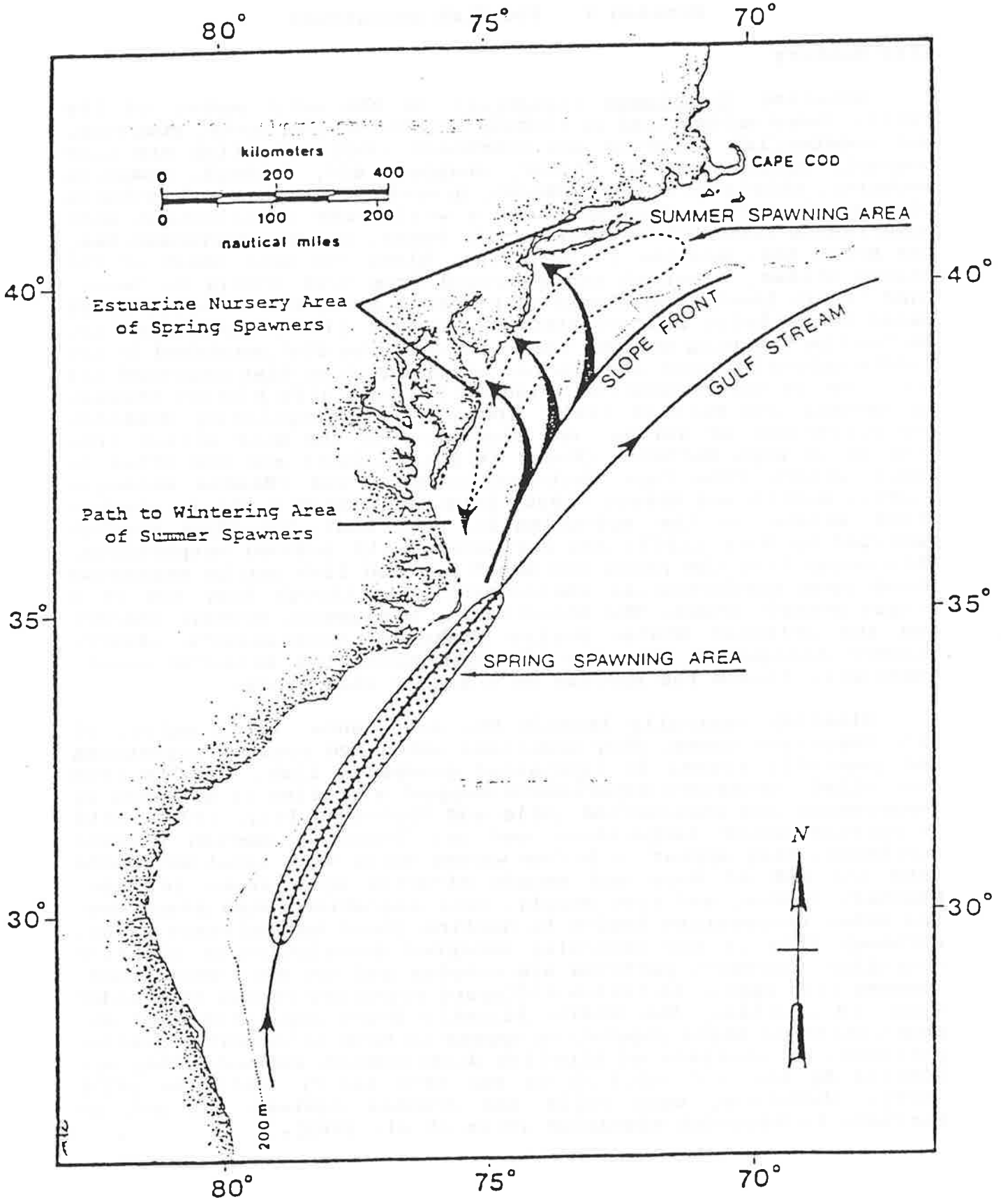


Figure 1. Spawning areas and coastal migration patterns for bluefish along the Atlantic Coast. (Wilk, 1977).

Adult bluefish are found in a variety of habitats, usually in response to food availability and spawning cues (Stagg 1986). They are voracious predators and will feed on virtually any food they can catch and swallow. The fishes most frequently comprising their diet include butterfish, menhaden, herring, sand lances, silversides, mackerel, anchovies, sardines, weakfish, spotted seatrout, croaker, and spot. In estuarine areas like the Chesapeake Bay, bluefish feed on bay anchovies, white perch, shad, alewife and blueback herring, and striped bass (Sargent and Boreman 1984). Due to their predacious nature, bluefish are in competition with adult striped bass, mackerel and large weakfish. They have few predators and can live up to 12 years.

Most bluefish mature at age II and are highly fecund. Fecundity (the number of eggs produced) is a function of size and age and has been estimated from 900,000 to 4,500,000 eggs per female (Wilk 1977). The distribution of bluefish eggs is related to temperature and salinity and can vary from year to year. Spawning and larval development take place offshore from April to May in southern waters and from June through August in the Middle Atlantic Bight (Kendall and Walford 1979). In a survey conducted in the Chesapeake Bight, bluefish spawned mainly over the outer half of the continental shelf with only a few eggs found in the Chesapeake Bay. In this area, bluefish eggs are most abundant in July. Optimum temperature and salinity for spawning in the Chesapeake Bight are 25.6°C (78°F) and 31 o/oo (Norcross et al. 1974).

Bluefish larvae can be found offshore between Cape Cod, Massachusetts, and Palm Beach, Florida, during every season of the year (Kendall and Walford 1979). Larval distribution is affected by the wind and currents. Larvae that originate from spawning off the Chesapeake Bay are carried south and offshore (Norcross et al. 1974). As larvae grow and are able to swim, they leave the surface for deeper water and move inshore. Upon completion of fin formation which occurs around 13 to 14 mm (0.5-0.6 inches), bluefish larvae are considered juveniles (Norcross et al. 1974).

Juvenile bluefish from the spring-spawning, South Atlantic stock, are found at the surface near the slope front (refer to Figure 1) from south of Cape Hatteras to the Middle Atlantic Bight during April through June. It is believed these juveniles move northward along the slope front, cross the shelf and enter the estuaries of the Middle Atlantic Bight, including Chesapeake Bay. After spending the summer in the estuaries, juvenile bluefish return to the coast and move southward. Most juvenile bluefish spawned during the summer in the Middle Atlantic Bight remain in coastal waters, but some may enter estuarine waters for a couple of months before they leave the Middle Atlantic Bight in early fall (Kendall and Walford 1979). Juveniles prefer water temperatures between 17.7 and 26.1°C (64-79°F) during the summer and between 15.0 and 17.2°C (59-63°F) during the fall (Kendall and Walford

1979). Thermal preferences may partly explain the distribution of juvenile and adult fish (MAFMC 1989). Onshore movements of juvenile bluefish into estuarine areas probably provide protection, food and shelter. The circulation of continental shelf waters is probably the most important factor in determining yearclass strength (Norcross et al. 1974).

Juvenile bluefish grow quickly and by late fall there are usually two size groups along the middle Atlantic and New England coasts. Those fish that were spawned in the south during the spring are 150-200 mm (6-8 inches) long, and those spawned in the summer are 50-100 mm (2-4 inches long) (Sargent and Boreman 1984). Growth rates of the summer-spawned fish exceed the spring-spawned fish during the second year. By age II and III, the size difference between the two groups is not as apparent. Mean lengths more than double between ages I and IV, then steadily decline thereafter (MAFMC 1989). Length at maturity (age II), generally ranges from 378 to 510 mm (14.9-20.1 inches) (Wilk 1979).

Biological Profile

Natural mortality rate:	29.5% annually.
Fecundity:	900,000 - 4,500,000 eggs/female.
Longevity:	11-12 years.
Spawning and Larval Development	
Spawning season:	April and May in southern waters; June through August in the Mid-Atlantic Bight, with peaks in July.
Spawning area:	Offshore coastal waters.
Location:	Most spawning occurs over the outer half of the continental shelf. In the Mid-Atlantic Bight, eggs have also been reported as far inshore as southern Chesapeake Bay. Eggs and larvae are most abundant in surface waters.
Salinity:	26.6 - 35 ppt.
Temperature:	17.8 - 26.1°C (64 - 79°F).
Young-of-Year	
Location:	Begin to move inshore after transformation from the larval stage

	is complete. Occur along coastal beaches and are widely distributed in Chesapeake Bay.
Salinity:	0 - 35 ppt.
Temperature:	15.0 - 26.1°C (59 - 79°F).
Dissolved Oxygen:	Probably at least 5 ppm.

Subadults and Adults

Location:	Estuarine and ocean waters.
Salinity:	0 - 35 ppt.
Temperature:	Between 17.7 and 23.3°C (64-74°)
Dissolved Oxygen:	Minimum about 5.0 ppm.

The Fishery

Commercial bluefish landings from the Chesapeake Bay began increasing dramatically in the 1970s with a record high catch of 4 million pounds in 1976 (Figure 2a). Over the next eight years, the harvest declined to 1 million pounds, then fluctuated around 1.5 million pounds. Between 1987-1988, the Maryland commercial bluefish harvest increased over 50% but most recently has decreased from 738,000 pounds in 1988 to 218,371 pounds in 1989. Between 1984 and 1987 the commercial harvest in Virginia averaged about 1.2 million pounds, increased to 2.6 million pounds in 1988, and decreased to approximately 780,000 pounds in 1989. It is apparent that the commercial catch statistics are highly variable from year to year, however, without effort information it is difficult to relate catch statistics to bluefish abundance.

Historically, the commercial bluefish harvest has been more important in Virginia than in Maryland (Figures 2b & c). At the peak harvest in 1976, Virginia caught approximately 88% of the total commercial landings from the Chesapeake Bay. The predominant commercial gear type used in harvesting bluefish from the Bay has been pound nets. Large numbers of small bluefish have been caught in Virginia pound nets and used as bait for the crab fishery. Other gears for harvesting bluefish include gill nets, otter trawls, haul seines, and hand lines (Figures 3a & b). Currently, all commercial gears, except Virginia's hook and line fishermen, are required to have a license. Most bluefish are commercially harvested in the Chesapeake Bay region from May to October (Stagg 1986).

Figure 2a. Commercial bluefish landings from the Chesapeake Bay

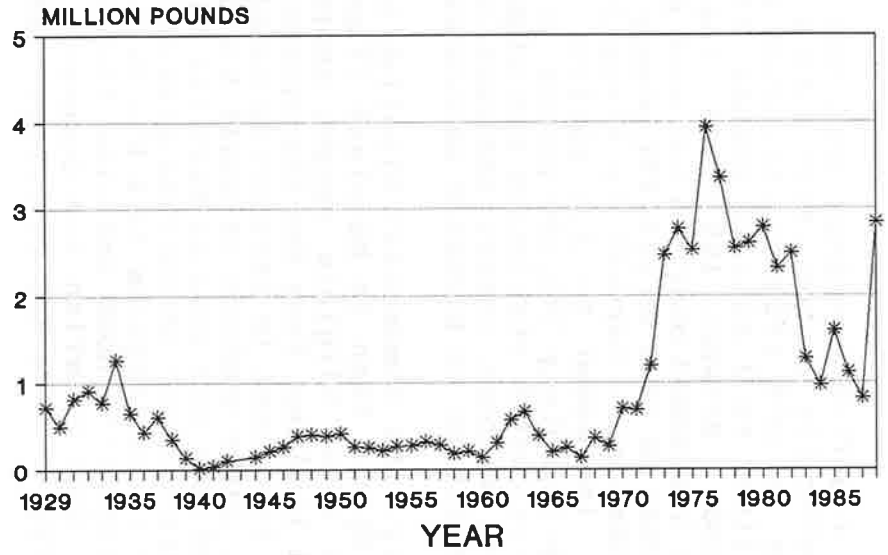


Figure 2b. Commercial bluefish landings from Maryland

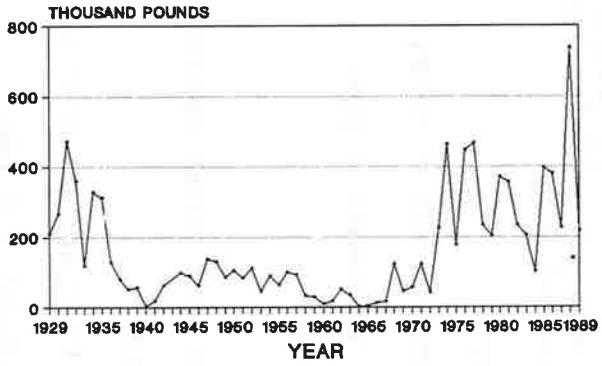


Figure 2c. Commercial bluefish landings from Virginia

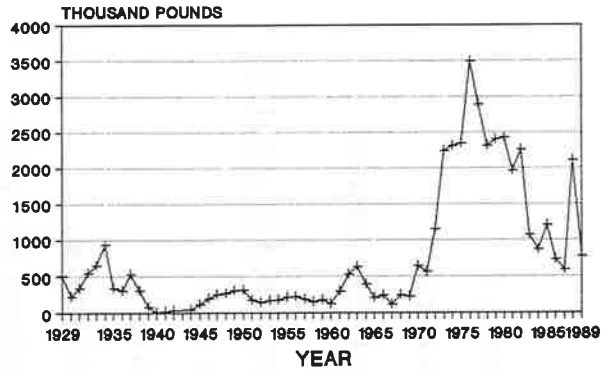


Figure 3a. Maryland commercial bluefish catch by gear type

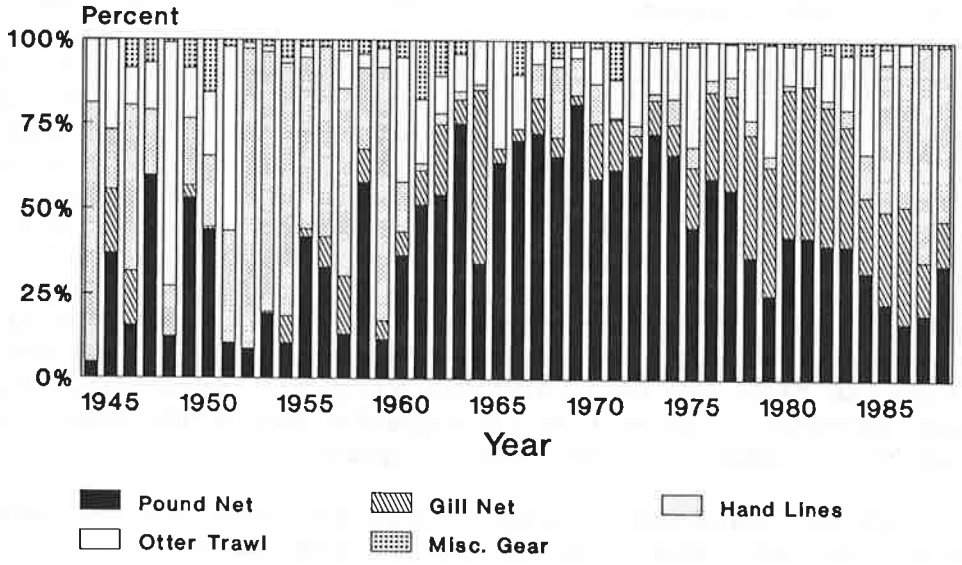
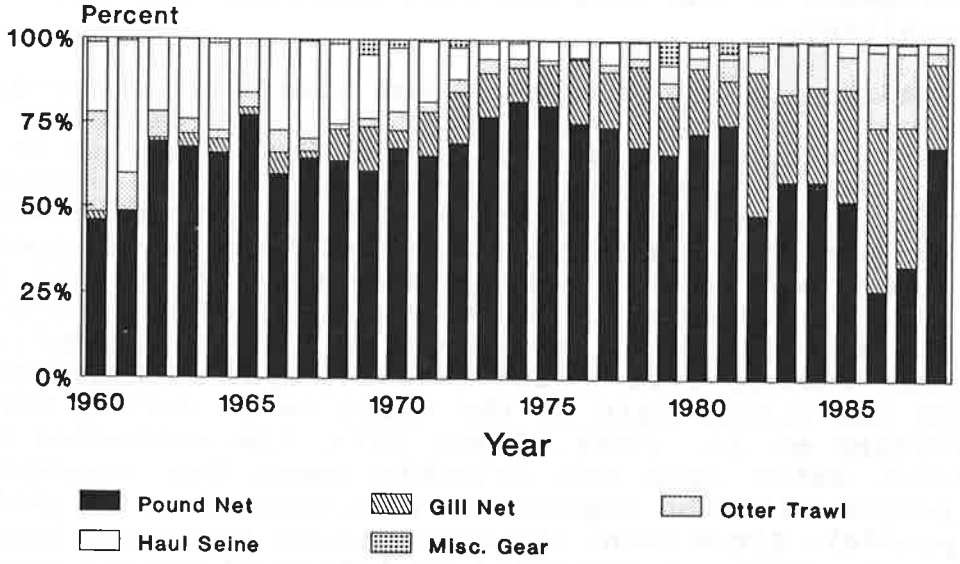


Figure 3b. Virginia commercial bluefish catch by gear type

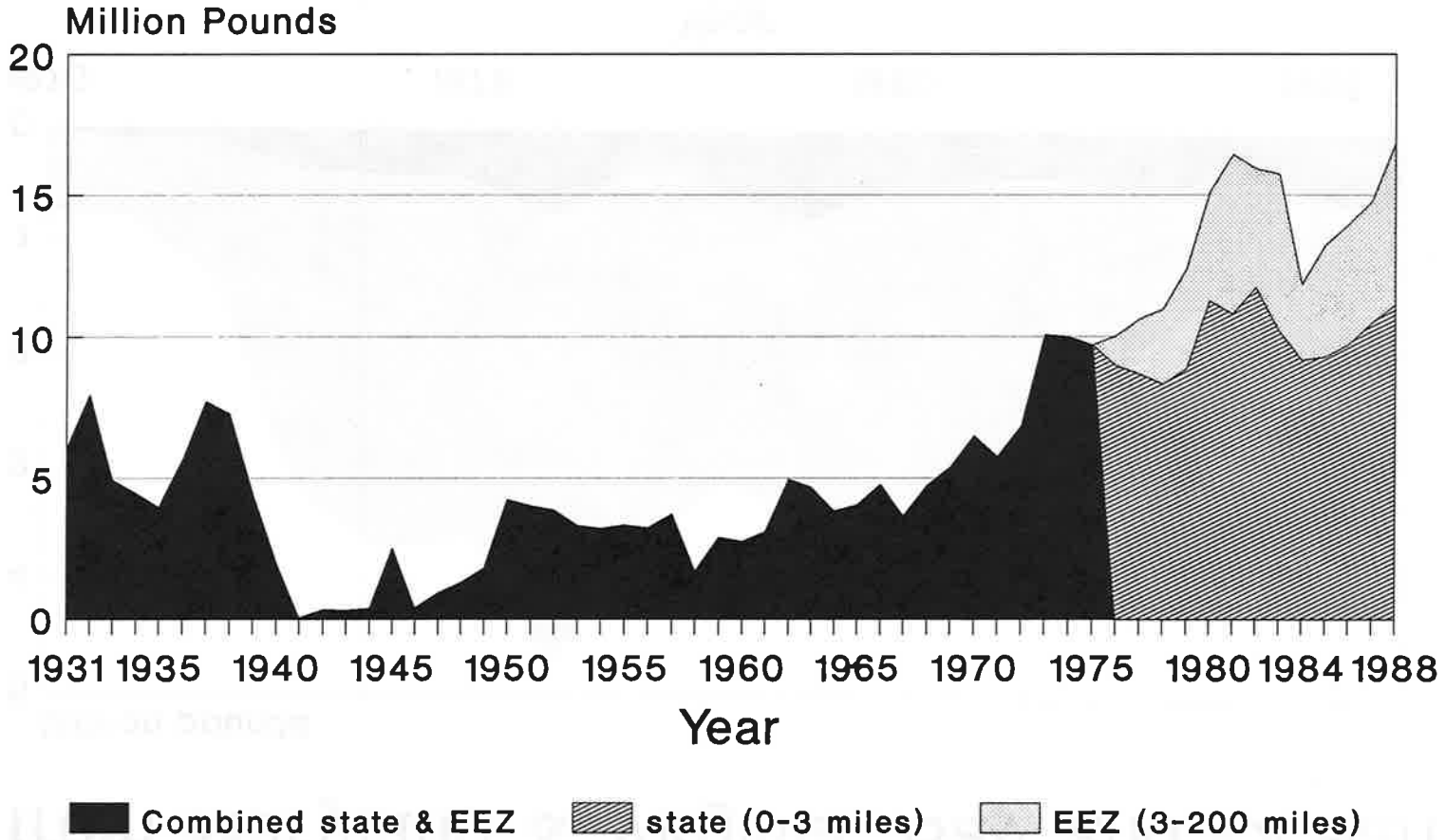


A discussion of the commercial bluefish fishery would not be complete without including an examination of the bluefish fishery along the Atlantic coast. As previously mentioned, bluefish are highly migratory and spawn in the Middle and South Atlantic bight regions. Harvest along the entire Atlantic coast may affect what is available in the Chesapeake region. During the 1950's and 1960's, bluefish commercial harvest from the Atlantic coast averaged less than 5 million pounds. Since 1979, bluefish commercial landings from the Atlantic coast have averaged approximately 14 million pounds per year (Figure 4). Bluefish are caught from both state (internal waters to 3 nautical miles offshore) and the Exclusive Economic Zone (EEZ) (3-200 miles) with the majority of landings from state waters. The Mid-Atlantic region (New Jersey to Virginia) has traditionally harvested 80% or more of the total bluefish landings from all of the Atlantic coast. Virginia has ranked second in commercial bluefish landings from the mid-Atlantic region, harvesting 18% of the total. Maryland has harvested about 3-5% of the mid-Atlantic total (Pottern et al. 1989). Bluefish from the Maryland and Virginia commercial fisheries are mainly harvested from the Chesapeake Bay with ocean landings accounting for a small percentage (Figure 5).

Although recreational surveys that include the Chesapeake Bay region are limited, the importance of the recreational bluefish fishery is obvious. During 1979 and 1980, bluefish recreational landings from Maryland tidal waters were estimated at 6,438,192 pounds and 9,589,604 pounds, respectively (Williams et al. 1982 & 1983). Compared to the commercial bluefish landings for these same years, 319,100 pounds and 437,334 pounds, respectively, the recreational harvest was more than twenty times as great. In the Chesapeake Bay, bluefish are the most sought-after species among recreational fishermen during May through October (Williams et al. 1983). Estimates of the 1988 and 1989 bluefish recreational catch are not available.

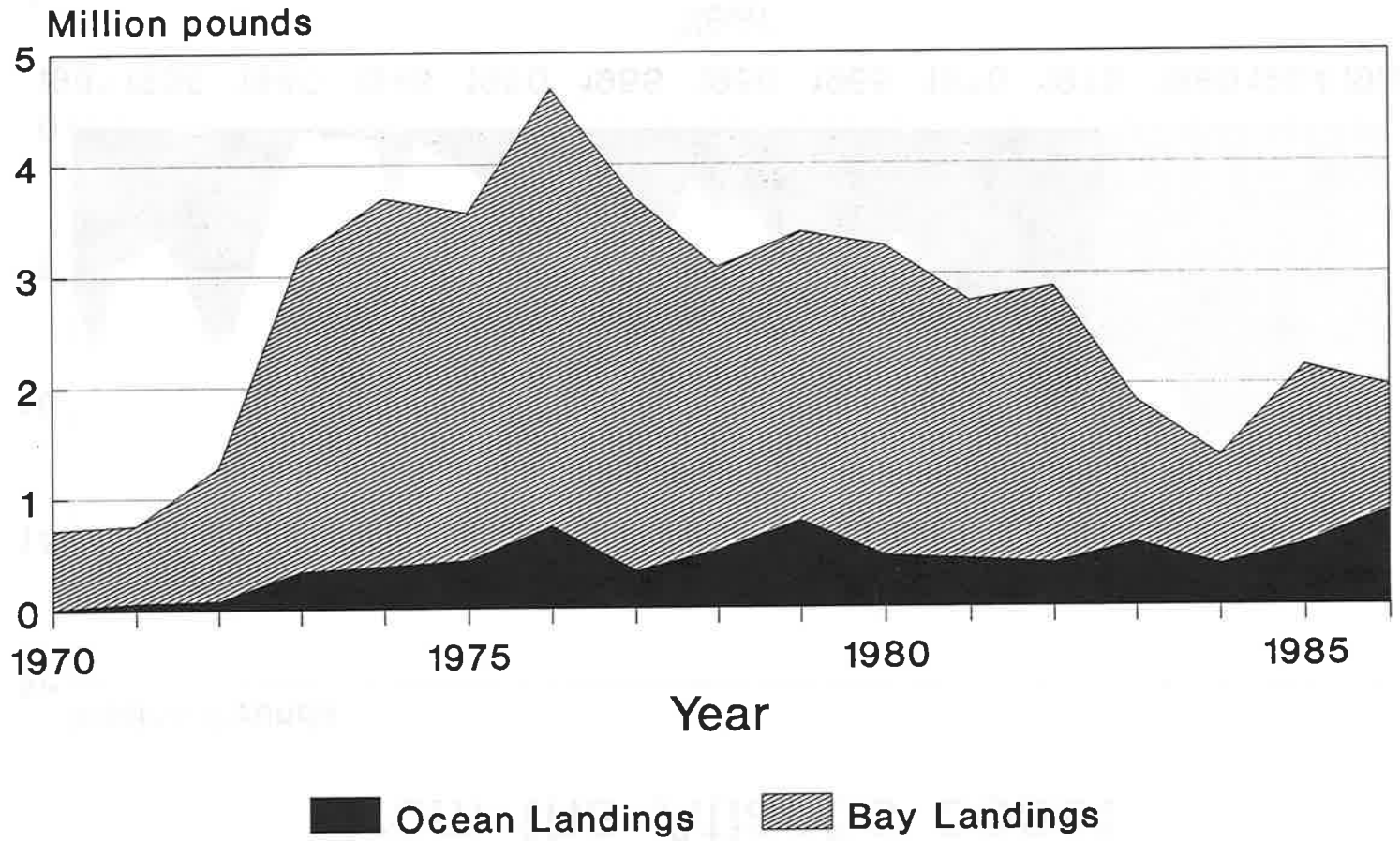
The importance of the recreational bluefish fishery along the coast can be dramatically represented. Although saltwater fishing surveys were conducted in 1960, 1965, and 1970, they are of limited value. The National Marine Fisheries Service has conducted an annual Marine Recreational Fishing Statistical Survey (MRFSS) since 1979 to the present. Bluefish have ranked first among sport fish, in both number and weight, nearly every year since 1970 (Pottern et al. 1989). Furthermore, in recent years, bluefish have comprised nearly 30% by weight of all species in the Atlantic coast recreational fishery with inland waters (bays, sounds, estuaries) accounting for almost half of the total catch during the past 8 years (Pottern et al. 1989). Since 1979, the estimated bluefish recreational catch from the Atlantic coast has averaged 111.7 million pounds with the highest harvest occurring in 1980 (153.5 million pounds). Since then, the recreational catch has been slowly decreasing. In 1989, an estimated 58.1 million pounds were caught by recreational fishermen (Figure 6).

Figure 4. Commercial bluefish landings from the Atlantic coast



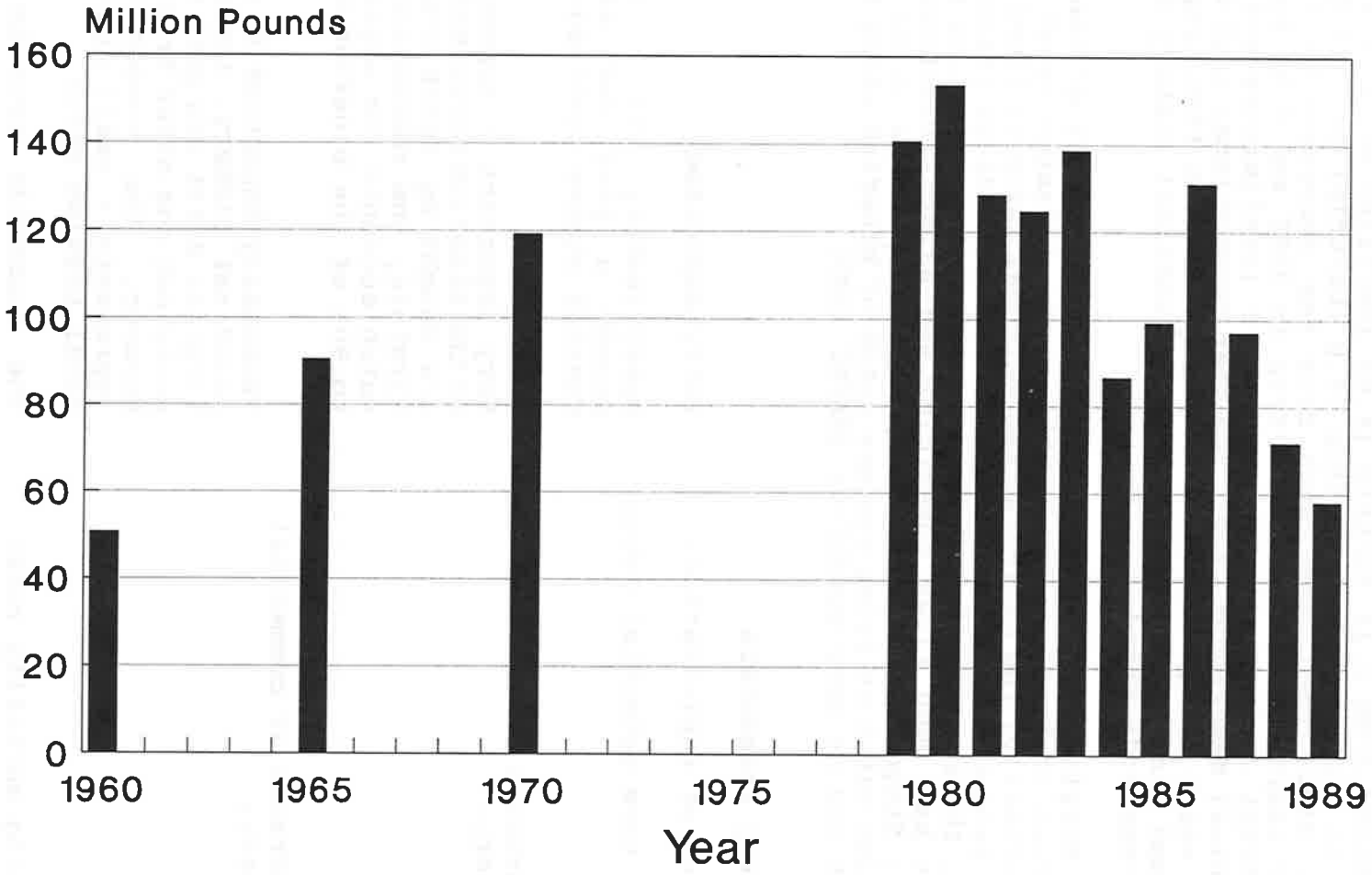
Data from MAFMC 1984

Figure 5. Commercial bluefish landings from Maryland & Virginia, Bay and Ocean



Landings by area not available till 1970

Figure 6. Estimated recreational bluefish landings, Atlantic coast



Data from MAFMC

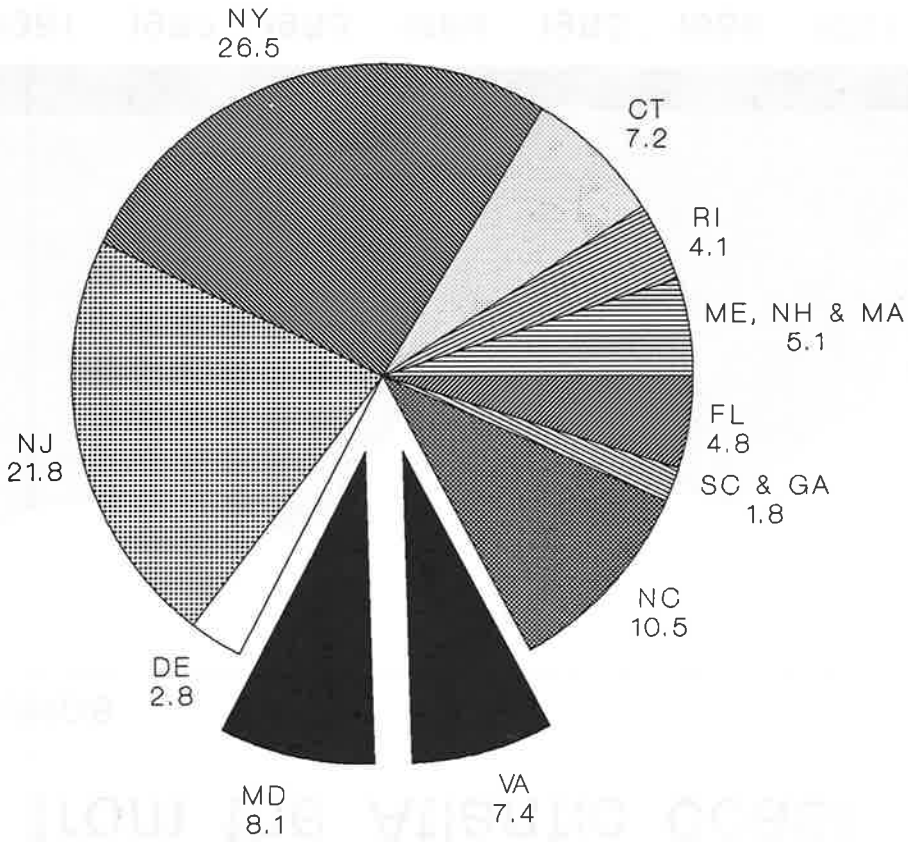
Catch-per-unit-of-effort data from the Atlantic coast recreational fishery suggest that recent exploitation has reduced bluefish abundance. The bluefish recreational catch per angler trip increased from 2.11 kg/trip (4.65 lbs/trip) or 1.18 fish/trip in 1979 to a peak of 2.72 kg/trip (6.0 lbs/trip) or 1.49 fish/trip in 1981. Since then, the catch rate has decreased to 1.35 kg/trip (2.97 lbs/trip) or 0.89 fish/trip in 1987 and 0.95 kg/trip (2.09 lbs/trip) or 0.42 fish/trip in 1988 (preliminary estimate, NOAA Technical Memorandum 1989). The mean recreational CPUE during 1979-1987 was 1.76 kg/trip (3.88 lbs/trip) or 1.06 fish/trip. It can be assumed that the Chesapeake Bay recreational fishery would follow the coastwide trend.

Maryland and Virginia accounted for 15.5% of the total 1989 bluefish recreational harvest from the Atlantic coast (Figure 7). Historically, the estimated recreational catch of bluefish has been much larger than the recorded commercial landings (Figure 8). Since 1979, the average distribution of bluefish catch along the Atlantic coast has been 11.2% commercial and 88.8% recreational (Boreman 1982; Stagg 1986; MAFMC 1989). To date, there is no appreciable foreign catch or joint venture catch of bluefish along the Atlantic coast and no user conflicts (MAFMC 1989).

Fishery Parameters

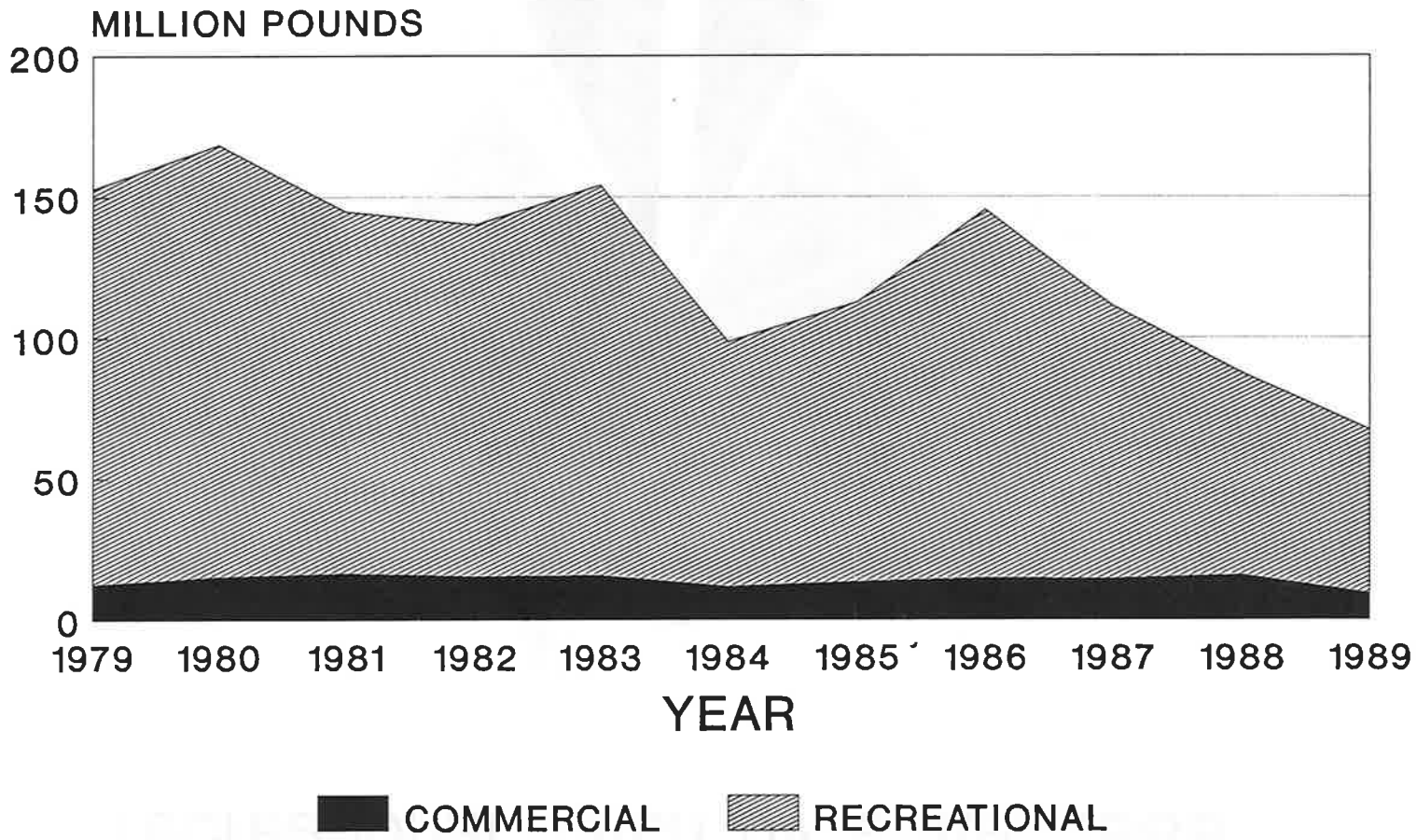
Status of exploitation:	Fully exploited.
Long term potential catch:	Approximately 137 - 150 million pounds a year for all Atlantic coastal states combined.
Importance of recreational fishery:	Very important - approximately 90% of the bluefish harvested in Maryland are caught by sport fishermen. In Virginia, the recreational bluefish catch accounts for approximately 80 to 90% of the bluefish harvest.
Importance of commercial fishery:	Seasonally important in the Maryland pound net fishery. Important in the Virginia drift and gill net fishery, pound net and otter trawl fisheries. However, the commercial harvest represents a small fraction of the total baywide catch.
Fishing mortality rate:	The coastwide rate is 26% - 33% annually.

Figure 7. Percentage of the bluefish recreational catch by state, 1989



Data from MAFMC

Figure 8. Total bluefish harvest from the Atlantic coast



Data from MAFMC

Economic Perspective

The dockside value of the bluefish commercial fishery in both Maryland and Virginia has increased since the late 1970s and early 1980s (Figure 9a & b). An analysis of current and deflated dollars for both the Maryland and Virginia commercial harvest from 1974 to 1982, however, indicated the value of the catch did not change markedly in either state (Stagg 1986). In comparison with other finfish from the Bay, bluefish have ranked as high as fifth in value from Maryland during 1987. This is a change since the early 1980s when bluefish ranked 10th or 13th in value.

The ex-vessel value of the commercial bluefish fishery from the Atlantic coast has steadily increased from $1.1 million in 1976 to as high as $3.7 million in 1982 (Figure 10). The average price per pound, adjusted for 1987 values, has varied from $0.18 to $0.27 per pound (MAFMC 1989). An extensive economic evaluation has not been done for bluefish due to the undeveloped nature of the bluefish market. What can be seen is a growing demand for bluefish and an increase in price. Since most of the commercial bluefish harvest is not a directed fishery but rather a bycatch from other fisheries, significant trends in market demands are not discernible (MAFMC 1989).

Determining the value of a recreational fishery is not a straightforward process. Usually, competitive market prices and quantities are used to determine value. However, a market price is not available for recreational fisheries and quantities are usually estimated. The "value" of a sportfishery has been estimated by utilizing the cost of a fishing trip (Norton et al. 1983). The factors contributing to the "value" of a fishing trip, such as number of fishing trips, fishing trips directed specifically towards bluefish, average cost per trip and total dollars expended, have been derived from the NMFS 1979-1982 surveys. Based on this information and the assumption that sportfishing in the Mid-Atlantic region is representative of sportfishing in the Chesapeake Bay, the economic value of the recreational bluefish fishery in the Chesapeake Bay was estimated at 20 to 30 million dollars annually from 1980 to 1982 (Stagg 1986). Using this limited estimation, the bluefish sportfishery was about 40 times more valuable than the commercial catch during this time period.

Likewise, estimating the "value" of the recreational bluefish fishery along the coast is a complicated task. The MRFSS data has been used to estimate economic activity associated with bluefish. For the 1985 recreational bluefish fishery on the Atlantic coast, associated retail sales were estimated between $390.7 and $574.1 million and wages were estimated between $79.7 and $117.0 million (MAFMC 1989). The value of a recreational fishing day has been estimated between $18.97 and $169 per day (Bell et al. 1982; Norton et al. 1983). The NMFS estimated that 2.5 million shore-based and 4.3 million boat-based trips targeted bluefish in 1985. By

Figure 9a. Commercial landings and dockside value for Maryland bluefish

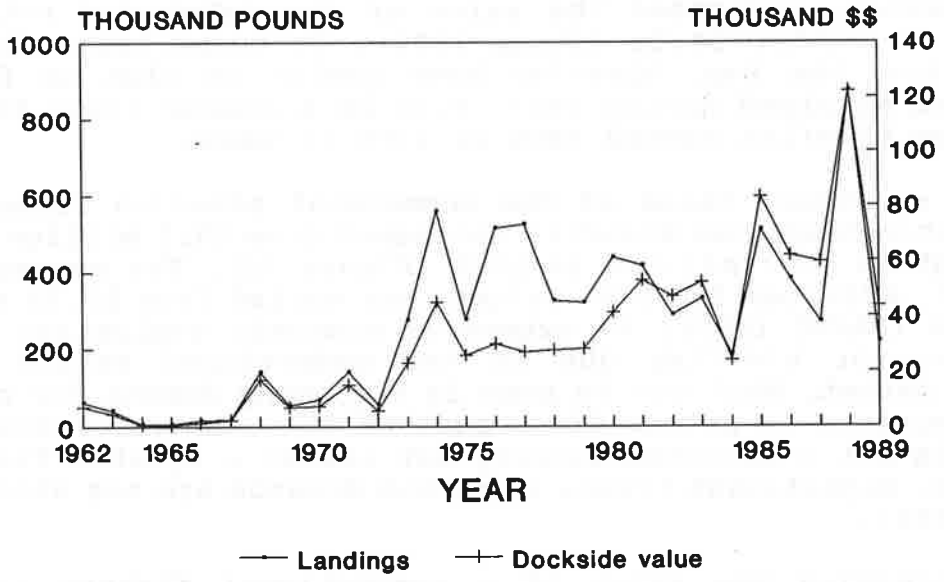


Figure 9b. Commercial landings and dockside value for Virginia bluefish

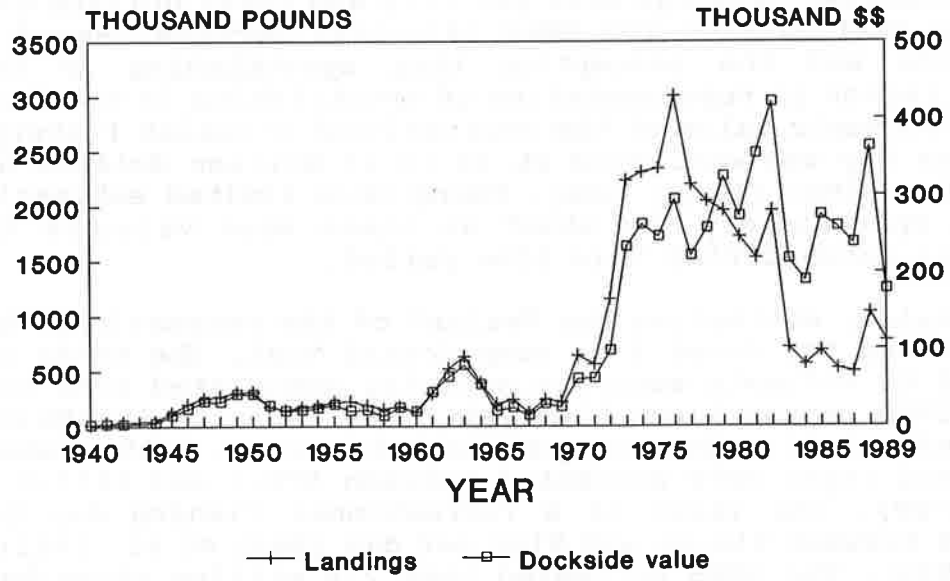
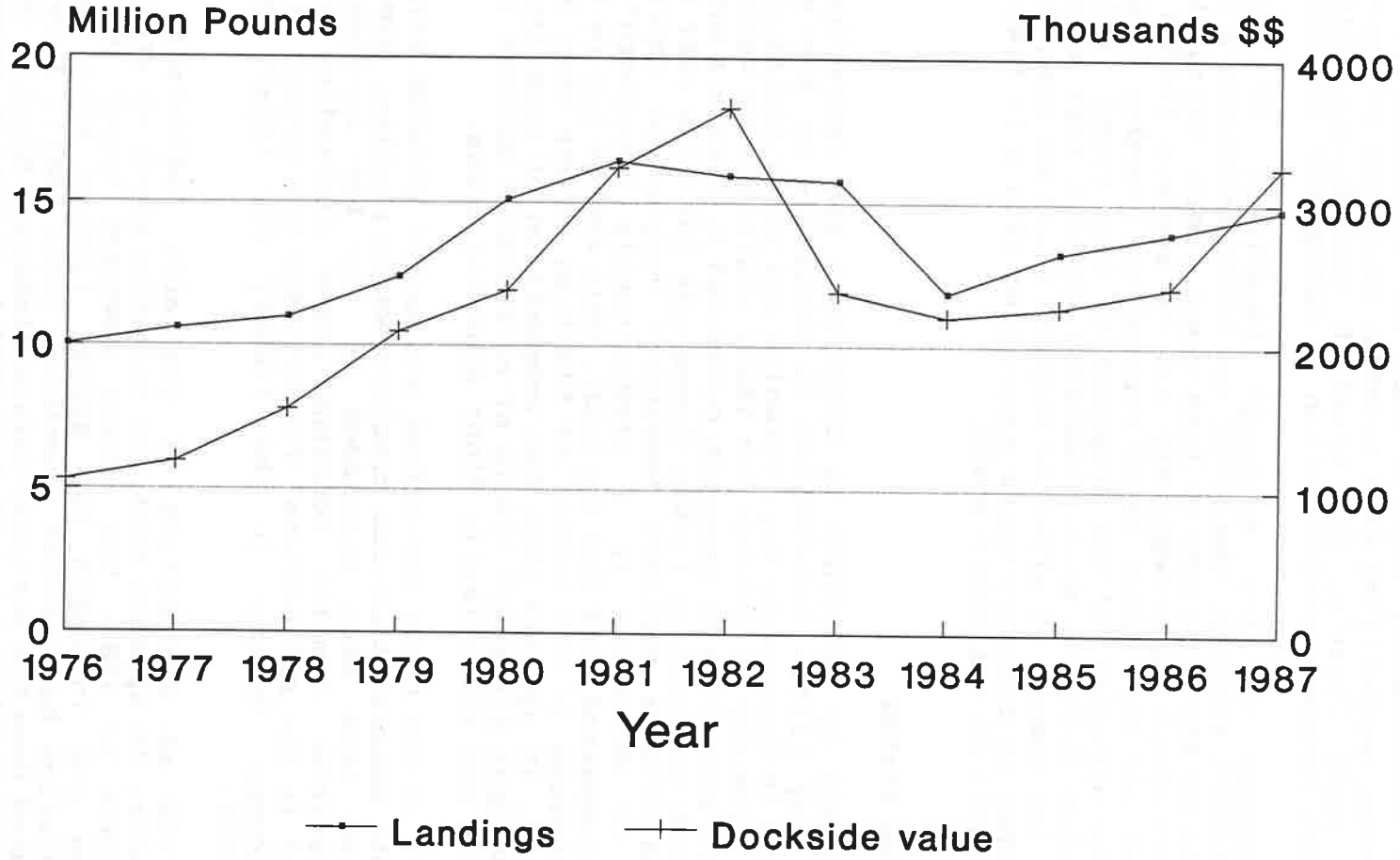


Figure 10. Commercial bluefish landings & dockside value from the Atlantic coast



Data from MAFMC 1989

multiplying the average value of a fishing day by the number of trips, the value of the bluefish recreational fishery from the Atlantic coast can be estimated. These values, however, do not include non-monetary aspects such as "enjoyment of the fishing experience, socializing with friends, being out on the water, etc." (MAFMC 1989) Clearly, the bluefish recreational fishery is an important economic consideration in management decisions.

Because of the economic importance of the bluefish recreational fishery, the MAFMC and ASMFC conducted a cost/benefit analysis of the proposed 10 fish creel limit. Using the data from the 1987 MRFSS, approximately 93% of anglers landed 10 or less bluefish per day. About 7% of recreational angler trips coastwide would be affected by the proposed 10 fish creel limit. With the assumption that the more successful anglers take more individual trips, the number of affected anglers would be even less than 7%. The change in economic value associated with a 10 fish limit would most likely be extremely small.

Resource Status

Except by reference to commercial and recreational harvest data, very little information is available on the abundance of bluefish in Chesapeake Bay. Juvenile and young adults are generally caught from May to October but their availability varies from year to year. According to research conducted by Austin & Graves (1990), the stock composition in the Chesapeake Bay from 1987 through 1989 changed from a dominant "northern" morphotype (spring-spawned, south of Hatteras) to a predominantly "southern" morphotype (summer-spawned, off New England). This change may be the cause of the decrease in the number of bluefish larger than 16 pounds in Virginia. It appears that the composition of bluefish in the Bay depends upon different levels of recruitment success in the south-Atlantic and mid-Atlantic Bight spawning areas.

It is not known how effort and market demands affect bluefish harvest, however they can create a waste problem. Numbers of dead bluefish have been discarded in the Bay because they were unmarketable. Similar concerns about discarding bluefish are present in the recreational fishery, but the extent of the problem is unknown. Wastage in the fishery may impact estimates of abundance.

From an examination of available indicators of bluefish abundance, it appears that the Atlantic stock or stocks increased from 1974 to 1983. The recent downward trend in recreational catches and in catch per angler fishing trip suggests that exploitation has reduced abundance (NOAA 1989). A juvenile index generated from the National Marine Fisheries Service (NMFS) inshore trawl survey indicated that bluefish yearclass success north of Cape Hatteras exhibited no evidence of decline from 1974 to 1986

(MAFMC 1989) but was highly variable. Based on the NMFS juvenile trawl survey, one of the strongest yearclasses was recorded in 1989. This strong yearclass accounted for the unusually high number of yearlings found in the Bay during 1990 (Austin and Graves 1990).

Modeling results suggest that highest sustainable yields for bluefish along the Atlantic coast range from 140 to 150 million pounds. The best and most recent assessments of the bluefish fishery suggest that the stock is fully exploited. Further, modeling results predict a decline in sustainable yield and recruitment if fishing rates increase (MAFMC 1989). Overfishing, the level of fishing which exceeds the ability of the stock to maintain the predicted maximum sustainable yield (MSY), would occur if fishing rates were higher than 0.35. The proposed MAFMC/ASMFC bluefish management measures are based on an estimated MSY of 140 to 150 million pounds. Since the recreational fishery accounts for 90% of the total bluefish harvest from along the Atlantic coast, a creel limit is proposed in order to stabilize recreational fishing levels. The commercial fishery will be limited to 20% of the total catch each year. The decision to implement commercial controls will be based on two separate indices and a two-tier approach (see the Coastal Management Measures section below or the 1989 MAFMC/ASMFC Bluefish management plan for details). Since bluefish abundance is highly cyclic (MAFMC 1984), the proposed management measures must take into consideration natural stock fluctuations. Conservative measures should benefit the stock even during an unpredictable, natural decline in abundance.

Habitat and Water Quality Issues

Estuarine, coastal and continental shelf areas are important habitats for bluefish. Bluefish eggs have been reported as far inshore as southern Chesapeake Bay. However, the Chesapeake Bay serves primarily as nursery and feeding habitat, with juveniles and adults found seasonally throughout the Bay. Young bluefish tend to concentrate in shoal areas and major tributaries where the salinity is lower. Estuarine habitats are among the most vulnerable to impacts from human activities, such as dredging, filling, construction and shore development, pollution, runoff, and waste disposal. The specific effects of many of these on bluefish reproduction, growth, and survival are unknown, but it is recognized that the loss and degradation of nursery and feeding grounds may be detrimental to bluefish populations.

Bluefish cannot tolerate low oxygen conditions. Periodic anoxic conditions in deep water of the middle Bay, probably limit bluefish distribution. Toxic substances, such as polychlorinated biphenyls (PCB's) and kepones, have been a major concern in coastal and estuarine areas because of the possible deleterious effects on human health. From the results of a PCB survey, the federal government has recommended that human consumption of large bluefish (greater than 19.7") be limited (NOAA/FDA/EPA 1986). During 1976,

PCB values of finfish from Chesapeake Bay (including bluefish) averaged 0.26 ppm, well below the FDA limit of 2.0 ppm (Eisenberg et al. 1980). From 1976 to 1988, the Virginia State Board of Health prohibited the consumption of bluefish from designated areas of the James River because of high concentrations of Kepone (MAFMC 1989). This ban was lifted in July, 1988.

FMP Status and Management Unit

The Mid-Atlantic Fishery Management Council (MAFMC) and the Atlantic States Marine Fisheries Commission (ASMFC) in cooperation with the National Marine Fisheries Service (NMFS), the New England Fishery Management Council, and the South Atlantic Fishery Management Council formally adopted a fishery management plan (FMP) for the bluefish fishery along the Atlantic coast in October, 1989. Although the Plan was adopted in October, the EEZ regulations actually became effective on May 31, 1990. This plan represents the nation's first joint interstate-EEZ Plan for an interjurisdictional fishery resource. The MAFMC/ASMFC plan serves as the basis for the Chesapeake Bay FMP.

The management unit for bluefish, Pomatomus saltatrix, is a single Atlantic coastal stock.

Coastal Management Measures

Based on the coastwide status of the bluefish resource and the structure of the fishery, the MAFMC and ASMFC have adopted the following management measures. The Chesapeake Bay jurisdictions will follow these measures as described in the management section of this plan.

Recreational Catch Limits

Anglers are restricted to a possession limit of no more than ten (10) bluefish or the equal or more stringent possession limit at the state of landing, if one exists. On vessels with several passengers, the number of bluefish contained on the vessel may not exceed ten (10) times the number of people aboard the vessel, excluding persons with commercial permits and their catch. Those with commercial permits are required to keep their bluefish separated from the recreational pooled catch and in their possession at all times. Commercial hook and line fishermen may take more than the recreational possession limit if they have a commercial permit.

Based on a recommendation by the MAFMC and ASMFC, the regional director of the NMFS and individual states may modify the possession limit to between zero (0) and fifteen (15) bluefish per angler in their respective jurisdictions.

Commercial Catch Limits

The commercial fishery, on a coastwide basis, is limited to 20% of the total catch (recreational catch plus commercial landings) each year. The decision to implement commercial controls on the bluefish fishery is based on two separate indices and a two-tier approach.

The first tier:

A. A three year moving average of both the commercial landings and total bluefish catch will be used to derive a time-series projection of the commercial share for the upcoming year. If the projected commercial share is 20% or above, then commercial controls will be implemented at the start of the upcoming year. If this percentage is between 17% and 20%, then policy makers will use the criteria of the second tier to determine if commercial controls will be implemented.

B. The percent of commercial landings in the total bluefish catch will be calculated for each year and compared to the commercial share for the previous year. If the change in the commercial percentage equals or exceeds 50%, then policy makers will use the criteria of the second tier to determine if commercial controls will be implemented.

The second tier:

If the projected commercial share based on the average catch for the previous three years is between 17% and 20% OR the commercial share increased 50% or more from the previous year, then the following steps will be used to determine if controls on the commercial fishery will be implemented for the upcoming year:

1. The most recent, complete year of data will be used to determine what factors led to the increase in commercial share.

2. In-season data will then be investigated to determine if the trends exhibited in the previous year are continuing. These data will include commercial landings by state, month, and gear and recreational catch by wave (2 month periods).

3. If an increasing trend in commercial landings was indicated for the current year then commercial controls will be implemented the following year. The type of control will be determined from examination of the above data.

If the catch in the commercial fishery is projected to equal or exceed the 20% limit during the upcoming year, then a state allocation system will be implemented. This entails the use of landings data from the most recent ten year period for each state

to determine the average percentage of coastwide commercial landings. These percentages will be used to determine the amount of the coastwide quota allocated to each state. Quotas apply to landings in each state regardless of where the bluefish are caught.

Individual states are responsible for ensuring that their individual quotas are not exceeded and may design specific management measures best suited to their state. States are encouraged to develop regimes that will provide fishing opportunities throughout the season for all bluefish fisheries. If the use of a highly efficient gear (purse seines, pair trawls, or runaround gill nets) is responsible for the increase in commercial landings, it will be regulated in EEZ waters. States are encouraged to implement companion regulations. Commercial controls will remain in effect until conditions in either the recreational or commercial fishery warrant a retraction. The Bluefish FMP Review and Monitoring Committee will annually review landing statistics to determine if commercial controls will be suspended.

In addition, any person selling bluefish must have a commercial fishing permit that allows the sale of bluefish. This commercial definition includes all hook and line fishermen who sell bluefish, regardless of fishing mode (that is, fishing from shore, manmade structures, private boats, party boats, or charter boats). For states without a permit, a federal permit is required to sell bluefish.

Laws and Regulations

Limited entry:

Maryland's Delay of Application Process, which went into effect September 1, 1989, requires previously unlicensed applicants to wait two years after registering with MDNR before a license to harvest finfish with commercial fishing gears will be issued.

Virginia - Proposed legislation authorizing the VMRC to limit or delay entry to fisheries (House Bill 286) was introduced to the 1990 Virginia General Assembly. The Bill was tabled and assigned to a legislative subcommittee for further study.

Potomac River - Current moratorium on any new commercial hook and line or gill net licenses, only Maryland and Virginia residents allowed to fish commercially.

Minimum size limit: Maryland- 8" total length; Potomac River- 8"; Virginia- None.

Creel limit: Not in effect for Maryland. Potomac River and Virginia established a 10 fish per person per day recreational creel limit in 1990.

Harvest quotas: Not in effect for Maryland, Potomac River or Virginia.

By-catch restrictions: None in effect.

Season: No closed season.

Gear - Area restrictions:

Maryland - purse seines, otter trawls, beam trawls, trammel nets, troll nets, drag nets and monofilament gill net prohibited. (Otter and beam trawls are legal on the Atlantic Coast at distances of one mile or more offshore). Prohibition on gill netting in most areas of Chesapeake Bay and its tributaries, except: (1) attended drift gill nets 2.5 to 3.5 inches stretch mesh may be fished outside the striped bass spawning reaches and; (2) anchor, stake and drift gill net 4.0 to 6.0 inches stretch mesh can be fished in Chesapeake Bay, excluding the tributaries south of Kent Point from June 1 to September 30, inclusive. Minimum stretch mesh size restrictions for pound net - 1.5", haul seine - 2.5".

Potomac River - Current moratorium on any new gill net or hook and line licenses. The use of a spear, gig, purse net, beam trawl, otter trawl, or trammel net are prohibited. Mesh size restrictions on pound net- 1.5", haul seine- 1.5", fyke net- 1.5", fish pot- 2.0", gill net 3.75" with a maximum of 7.0". Length limitations on pound net (1200'), stake gill net (600'), anchor gill net (600' X 12'), fyke net (400'), haul seine (1200' or 2400'), fish pot (10'). Seasonal restrictions: Pound net- February 15 through December 15; Anchor or stake gill net- June 1 through November 30; Drift gill net- closed; Haul seine-January 1 through December 31 except Saturdays June 1

through August 31 and Fridays and Saturdays September 1 through May 31.

Virginia - Trawling prohibited in the Chesapeake Bay. It is unlawful to set, place or fish a fixed fishing device of any type within three hundred yards in either direction from the Chesapeake Bay Bridge Tunnel. From April 1 through 31 May the spawning areas of the James, Pamunkey, Mattaponi, and Rappahannock Rivers are closed to stake and anchor gill nets. Striped bass taken in spawning areas by any gear must be released immediately.

Minimum stretch mesh size restrictions: pound net, 2"; gill net, 2 7/8" (increased to 3" in 1992); haul seine, 3" (nets over two hundred yards long). Additionally, no haul seine can be longer than one thousand yards in length or deeper than forty meshes. Any gill net, whether floating or submerged, that is not assigned a fixed location shall be set in a straight line, have no greater depth than 330", shall not exceed 1200' in length, and shall be fished no closer than 200 feet to any other such gill net. Gill nets are prohibited in the Lower Hampton Roads area from the Friday preceding Memorial Day to Labor Day, both days inclusive, from 7:00 A.M. to 5:00 P.M.; gill nets are prohibited in four Eastern Shore Bayside creek mouths (the Gulf, Hungars Creek, Nassawadox Creek and Occohannock Creek) from June 1 to October 1. Also, Sections 28.1-52 and 28.1-53 of the Code of Virginia outline placement, total length and distance requirements for fishing structures.

Status of Traditional Fishery Management Approaches

The following definitions have been adapted from the document, "Status of the Fishery Resources Off the Northeastern United States for 1989" (NOAA Technical Memorandum NMFS-F/NEC-72). For a more thorough review of fisheries terminology, refer to this document under the section "Definition of Technical Terms."

Catch-Effort: Defined as the number or weight of fish caught during a specific unit of fishing time and considered a basic measure of abundance or stock density.

Historical commercial fisheries catch data exist for Chesapeake Bay, however, it is difficult to utilize since there is little species-specific effort data. The estimated CPUE (number/trip) for bluefish derived from the recreational survey data from the Atlantic coast have trended downward since 1981 (MAFMC 1989).

Estimates of mortality: Defined as the rate at which fish die from natural causes or fishing. Conceptually, the easiest way to describe mortality is by using the total annual mortality rate, the fraction of the fish alive at the beginning of a year that die during the year. For example, a total annual mortality rate of 0.50 means that 50% of the population of fish died for whatever reason during the year. Annual rates are easy to understand but difficult to use when describing the relative contribution of different types of mortality, such as fishing and natural causes, to the total mortality of fish during a year.

To overcome this limitation, instantaneous rates, the fraction of the population of fish that dies in each very short period of time, are used because they are mathematically easier. Instantaneous total mortality (Z) can be represented mathematically by the natural logarithm of a ratio of the number of fish alive at the end of a unit of time, to the number alive at the beginning of the unit of time. If a year is divided into a large number (n) of equal time intervals, Z/n is the proportion of the population which dies during each time interval. For example, if Z = 1.7 and a day represents the time interval, then approximately 1.7/365 or 0.466% of the population is dying daily.

The part of the total mortality rate applying to a fish population that is caused by man's harvesting is considered the fishing mortality rate (F). Fishing mortality rates are estimated using a variety of techniques, depending on the available data for a species or stock. For example, if F = 1.5, then approximately 1.5/365 or 0.411% of the population dies each day from fishing. The part of the total mortality rate applying to a fish population attributed to natural causes is usually assumed to mean all causes other than fishing. Natural mortality rates (M) are usually expressed as an instantaneous rate and are difficult to estimate.

There are no estimates of bluefish mortality from the Chesapeake Bay. Total annual mortality for the Atlantic bluefish population is estimated at 69% to 75% over all ages; annual fishing mortality is estimated at 27% for large fish and up to 70% for small fish (due to their greater vulnerability to inshore fishermen); and annual natural mortality is estimated at 59% to 63% for large fish and 18% to 50% for small fish (Pottern et al.1989). Total mortality rates (Z) for adult bluefish estimated from catch curve analysis and age composition data from Atlantic coast fisheries range from 0.6 to 0.8 (MAFMC 1989). Instantaneous natural

mortality rates (M) range from 0.32 to 0.39, therefore, 0.35 is a reasonable estimate of M for age 1 and older bluefish (MAFMC 1989).

Yield-per-Recruit: A mathematical calculation of the theoretical yield that would be obtained from a group of fish of one age if they were harvested according to a certain exploitation pattern over the life span of the fish.

Yield-per-recruit for the East coast stock as a whole is maximized by delaying fishing until bluefish reach 18" total length at F = 0.25 - 0.40

Stock-Recruitment: The relationship between the number of adults and the amount of fish, in numbers or weight, that reach a certain size or age in a specific year. For example, the weight or number of fish that grow to become vulnerable to the fishing gear in one year would be the recruitment to the fishable population in that year. Recruitment is also used in referring to the number or weight of fish from a year class reaching a certain age and is often used to describe the strength of a year class.

Merging Atlantic Coast spawning stock size (which accounted for 14.5% of recruitment variability) and March wind stress vectors into an environmentally dependent stock recruitment model explained over 86% of the recruitment variability occurring from 1974 - 1986. Recent stock assessment indicates that year class recruitment is highly variable and that three strong year classes have been produced at irregular intervals since 1974 (MAFMC 1989).

Maximum Sustainable Yield: The number or weight of fish in a stock that can be taken by fishing without reducing the stock's biomass from year to year, assuming that environmental conditions remain the same.

Equilibrium yield models indicate that the highest sustainable yield for the Atlantic Coast is 137 - 150 million pounds a year. This yield occurs at F = 0.30 and 0.40. These models also predict stock collapse, if F exceed 0.50 - 0.60 for 10 to 15 years (MAFMC 1989).

Virtual Population Analysis: Defined as an analysis of the catches from a given year class over its life in the fishery. If 10 fish were caught each year from the 1968 year class for 10 successive years from 1970 to 1979 (age 2 to 11), then 100 fish would have been caught from the 1968 year class during its life in the fishery. Since 10 fish were caught during 1979, then 10 fish must have been alive at the beginning of that year. At the beginning of 1978, there must have been at least 20 fish alive because 10 were caught in 1978 and 10 more were caught in 1979. By working backward year by year, one can be virtually certain that at least 100 fish were alive at the beginning of 1970. A virtual population analysis goes a step further and calculates the number of fish that must

have been alive if some fish also died from causes other then fishing. Accuracy depends on the rate of population decline and the correctness of the starting value of the fishing mortality rate.

Most recent modified and revised estimates of the bluefish stock size from the Atlantic coast range from 142 to 150 million pounds (MAFMC 1989).

Data and Analytical Needs

1. Determine annual estimates of catch and effort in the commercial and recreational fisheries.

2. Determine annual estimates of the age, length and sex composition of the commercial and recreational catch.

3. Determine the level of discard in the commercial and recreational fisheries.

4. Determine the effects of hooking mortality by gear type and fish size relative to implementation of proposed bag and size limits in the recreational fishery.

5. Evaluate the economic effects of proposed ASMFC regulations on the recreational and commercial bluefish fisheries in Maryland and Virginia.

6. Investigate the principal environmental factors affecting year class strength.

7. Determine if the south-Atlantic spring-spawning stock and the mid-Atlantic summer-spawning stock are truly separate stocks by examining the genetic integrity of the populations, both temporally and spatially.

References

Austin, H. and J Graves. 1990. Stock identification of mid-Atlantic weakfish, Cynoscion regalis, bluefish, Pomatomus saltatrix, and summer flounder, Paralichthys dentatus, using electrophoresis. Part I, Bluefish. Final Report to the VMRC from VIMS, Contract Number WB-86-02/F-60-R, 62 pages.

Bigelow, H.B., and W.C. Schroeder. 1953. Fishes of the Gulf of Maine. U.S. Fish Wildl. Serv., Fish. Bull. 53, 577 p.

Boreman, J. 1982. Status of bluefish along the Atlantic Coast, 1982. NMFS, NE Fisheries Center, Woods Hole, Massachusetts. Ref. Doc. No. 83-28. 35 pp.

Eisenberg, M., R. Mallman, and H.S. Tubiash. 1980. Polychlorinated biphenyls in fish and shellfish of the Chesapeake Bay. Mar. Fish. Rev. February 1980:21-25.

Kendall, A.W., Jr. and L.A. Walford. 1979. Sources and distribution of bluefish, Pomatomus saltatrix, larvae and juveniles off the east coast of the United States. Fish. Bull. 77(1):213-227.

MAFMC (Mid-Atlantic Fishery Management Council). 1984. Bluefish fishery management plan. Dover, Delaware.

MAFMC (Mid-Atlantic Fishery Management Council). 1989. Bluefish fishery management plan. Dover, Delaware.

Morin R.P. and C. Bonzek. 1988. Maryland fisheries statistics. Maryland Dept. of Natural Resources, Completion Rept. Project 3-413-D-1. 34pp.

National Oceanic and Atmospheric Administration (NOAA). 1989. Status of the fishery resources off the northeastern United States for 1989. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-F/NEC-72. 110 pp.

National Oceanic and Atmospheric Administration/Food and Drug Administration/Environmental Protection Agency (NOAA/FDA/EPA). 1986. Report on 1984-86 federal survey of PCBs in Atlantic coast bluefish. Data Rep. NTIS PB86218070/AS.

Norcross, J.J., S.L. Richardson, W.H. Massmann, and E.B. Joseph. 1974. Development of young bluefish (Pomatomus saltatrix) and distribution of eggs and young in Virginian coastal waters. Trans. Amer. Fish. Soc. 3:477-497.

Norton, V., T. Smith, and I. Strand. 1983. Stripers:The economic value of the Atlantic coast commercial and recreational striped bass fisheries. University of Maryland, Sea Grant Publication No. UM-SG-TS83-12.

Olla, B.L. and A.L. Studholme. 1971. The effect of temperature on the activity of bluefish, Pomatomus saltatrix L. Biol. Bull. 141:337-349.

Olla, B.L. and A.L. Studholme. 1972. Daily and seasonal rhythms of activity in the bluefish, Pomatomus saltatrix. In H.E. Winn and B.L. Olla, Eds., Behavior of Marine Animals: Recent Advances. Vol. 2, Chapter 8:303-326. Plenum Publishing Corp., N.Y.

Olla, B.L., A.L. Studholme, and A.J. Bejda. 1985. Behavior of juvenile bluefish Pomatomus saltatrix in vertical thermal gradients: influence of season, temperature acclimation and food. Mar. Ecol. Prog. Ser. 23:165-177.

Pottern, G.B., M.T. Huish, and J.H. Kerby. 1989. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (mid-Atlantic)- bluefish. U.S. Fish Wildl. Serv. Biol. Rep. 82(11.94). U.S. Army Corps of Engineers, TR EL-82-4. 20pp.

Sargent, W. and J. Boreman. 1984. Bluefish: Biology and management along the Atlantic Coast. NE Fisheries Center, Woods Hole Laboratory, Woods Hole, Massachusetts. 6 pp.

Stagg, C. 1986. An evaluation of the information available for managing Chesapeake Bay fisheries: Preliminary stock assessments. Volume II. University of Maryland, UMCEES (CBL) 86-45.

Wilk, S.J. 1977. Biological and fisheries data on bluefish, Pomatomus saltatrix (Linnaeus). Sandy Hook Laboratory, Northeast Fisheries Center, NOAA Technical Ser. Report No. 11, 56 pp.

Williams, J.B., T.P. Smith, H.J. Speir, and S. Early. 1983. 1980 Maryland Saltwater Sport Fishing Survey. Maryland Dept. Natural Resources Tidewater Admin. Rept. TA-CRD-83-1. 124pp.

Williams, J.B., H.J. Speir, S. Early, and T.P. Smith. 1982. 1979 Maryland Saltwater Sport Fishing Survey. Maryland Dept. Natural Resources Tidewater Admin. Rept. TA-CRD-82-1. 100pp.

Section 2. Bluefish Management

The source document for the management section is the coastwide "Fishery Management Plan for the Bluefish Fishery, 1989" prepared by the Mid-Atlantic Fishery Management Council (MAFMC) and the Atlantic States Marine Fisheries Commission (ASMFC) in cooperation with the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), the New England Fishery Management Council (NEFMC), and the South Atlantic Fishery Management Council (SAFMC). The coastal plan is intended to avert potential problems and to improve current management practices. The development of the Chesapeake Bay bluefish management plan has been prepared by the Maryland Department of Natural Resources (MDNR), the Potomac River Fisheries Commission (PRFC), and the Virginia Marine Resources Commission (VMRC). The Chesapeake Bay Bluefish Management Plan is intended to avert potential problems with the bluefish recreational and commercial fisheries in the Bay, focus on problems and needs of the fishery unique to the Bay area, and facilitate interjurisdictional management of the species. Existing regulations regarding the harvest of bluefish will continue to be enforced except where otherwise indicated by the plan.

A. GOAL AND OBJECTIVES

The goal of this plan is to:

> Protect and monitor the bluefish resource in the Chesapeake Bay, its tributaries and state coastal waters, and provide for the greatest long term ecological, economic, and social benefits from the resource.

In order to achieve the goal, the following objectives must be met:

1) Follow the guidelines established by MAFMC and ASMFC for coastwide management of bluefish stocks and make Bay management actions compatible where possible.

2) Promote protection of the resource by maintaining a clear distinction between conservation goals and allocation issues.

3) Provide for fair allocation of allowable harvest, consistent with traditional uses, among the various components of the fishery.

4) Promote harvesting practices which minimize waste and maximize the biological and economic return from the resource.

5) Promote studies to improve the understanding of economic, social, and biological aspects of the fishery.

6) Continue to provide guidance for the development of water quality goals and habitat protection necessary to protect the bluefish population within the Bay and state coastal waters.

B. PROBLEM AREAS AND MANAGEMENT STRATEGIES

Problem 1 - Stock Status and Increased Fishing Pressure: Bluefish abundance appears variable, and although recent commercial and recreational harvests are currently at a high level there is always the possibility of an unpredictable, natural decrease. Modeling results indicate that the highest sustainable yields for bluefish along the coast range from 137 to 150 million pounds. Since 1979, total bluefish catch from the coast has been in this range six times and exceeded the range three times. Recent evaluation of the bluefish stock along the Atlantic coast suggests fishing has reduced abundance and the stock is currently being fully exploited. Effective management necessitates cooperation among the coastal Atlantic states.

In the Chesapeake Bay, the bluefish commercial harvest increased by more than 50% between 1987 and 1988 then decreased by over 50% in 1989. Currently, the market demand and price for bluefish are unstable but the fishery has the potential to expand. Bluefish continue to be one of the most popular sport fish in the Bay and along the coast. Recreational harvest accounts for approximately 90% of the total catch. Currently, there are no creel limits on bluefish and the number of fishermen is increasing. Since the bluefish resource is believed to be fully exploited, conservative management practices are necessary to protect the stock from overexploitation. At the same time, the bluefish stock can continue to support both the recreational and commercial fisheries.

Strategy 1 - Stock Status and Increased Fishing Pressure: In order to protect the bluefish resource in the Chesapeake Bay and along the Atlantic coast from overexploitation, stock levels and fishing rates need to be monitored. Appropriate management actions may be needed if stock levels continue to decline and harvest levels continue to increase.

PROBLEM 1.1
There is a growing concern that continued increases in fishing effort by both the commercial and recreational fishery will lead to over-exploitation of the bluefish stock. Currently, there are gear limitations in effect and regulations on harvest for both the recreational and commercial fisheries are minimal.

STRATEGY 1.1.1
Since bluefish are a highly migratory species harvested along the Atlantic coast, Maryland, the Potomac River Fisheries Commission, and Virginia will cooperate with the Mid-Atlantic Fishery Management Council and the Atlantic States Marine Fisheries Commission to solve interjurisdictional problems in managing the bluefish stock.

ACTION 1.1.1
Maryland, the Potomac River Fisheries Commission, and Virginia will continue to participate in scientific and technical meetings for managing bluefish along the Atlantic coast and in estuarine waters.

IMPLEMENTATION 1.1.1
Continuing.

STRATEGY 1.1.2
Maryland, the Potomac River Fisheries Commission, and Virginia will monitor the bluefish fisheries in the Chesapeake Bay and in state coastal waters and implement conservative management measures for the fisheries as needed.

ACTION 1.1.2.1
Maryland, the Potomac River Fisheries Commission, and Virginia will adhere to state allocations established by the MAFMC and ASMFC if the commercial harvest is projected to equal or exceed 20% of the total bluefish catch from the Atlantic coast. Commercial harvest controls will be coordinated among Bay jurisdictions and will be consistent with those established in federal waters. Options may include gear restrictions, areal closures, trip limits, and quotas.

IMPLEMENTATION 1.1.2.1
Dependent on harvest trends.

ACTION 1.1.2.2
A) Maryland, the Potomac River Fisheries Commission, and Virginia will continue current licensing requirements for the commercial harvest and sale of bluefish.
B) Virginia will institute a 10 fish creel limit for the commercial harvest of bluefish by hook and line and work towards establishing a commercial hook and line license.

IMPLEMENTATION 1.1.2.2
A) 1991 B) Open

ACTION 1.1.2.3
Maryland will establish a 10 fish per person per day recreational creel limit at present minimum size limits for the Chesapeake Bay and state coastal waters. Virginia and the Potomac River Fisheries Commission established a 10 fish per person per day recreational limit in summer 1990. Upon a recommendation from the MAFMC and ASMFC, or as otherwise determined to be appropriate, jurisdictions may modify the possession limit and/or minimum size limit.

IMPLEMENTATION 1.1.2.3
1991

Problem 2 - Wasteful Harvest Practices: Waste of bluefish harvest has been reported for both the commercial and recreational fisheries. Unmarketable bluefish from the commercial fishery have been discarded in the Bay. Recreational fishermen also discard excess bluefish that have been caught by hook and line.

Strategy 2 - Wasteful Harvest Practices: There will be a baywide effort to eliminate and/or minimize wasteful harvest practices in the bluefish commercial and recreational fisheries.

PROBLEM 2.1
Dead bluefish are discarded in the Bay by both commercial and recreational fishermen.

STRATEGY 2.1
Efforts will be made to reduce the discard of dead bluefish in the Chesapeake Bay.

ACTION 2.1.1
Virginia and the Potomac River established a 10 fish per person per day recreational creel limit and Maryland will establish a 10 fish creel limit to minimize wastage (see Action 1.1.2.3).

IMPLEMENTATION 2.1.1
1991

ACTION 2.1.2
Maryland, the Potomac River Fisheries Commission, and Virginia will educate the general public, through the use of informational brochures and other means, about the need to reduce the waste problem

in the bluefish fishery. Hook and release will be promoted as one method for reducing waste in the fishery.

IMPLEMENTATION 2.1.2
1991

ACTION 2.1.3
Maryland, the Potomac River Fisheries Commission, and Virginia will begin assessing factors contributing to waste in the commercial bluefish fishery and identifying potential solutions. Issues to be considered include migratory patterns of bluefish, bycatch, the bait fishery, and market demand.

IMPLEMENTATION 2.1.3
1991

Problem 3 - Research and Monitoring Needs: The bluefish population along the Atlantic coast is believed to be fully exploited. There is very little known about the population dynamics of bluefish in Chesapeake Bay. Their occurrence, distribution, and abundance is highly variable from year to year. Additional information on catch and effort is needed to monitor and protect the bluefish resource in the Bay and along the coast. Currently, the economic value of the bluefish recreational fishery in the Chesapeake Bay can only be deduced from surveys taken along the coast.

Strategy 3 - Research and Monitoring Needs: In order to increase the knowledge and understanding of the bluefish fishery in the Chesapeake Bay, the jurisdictions will monitor the commercial and recreational fishery and improve catch and effort data. The jurisdictions will also pursue studies to evaluate the economic aspects of the bluefish fishery.

PROBLEM 3.1
There is a lack of information about the bluefish fishery in Chesapeake Bay. In order to monitor stock levels and improve management, additional data on bluefish biology and catch and effort is needed.

STRATEGY 3.1
Maryland, the Potomac River Fisheries Commission, and Virginia will increase the knowledge and understanding of the bluefish fishery in the Chesapeake Bay.

ACTION 3.1.1
Maryland, the Potomac River Fisheries Commission, and Virginia will improve the catch and effort data collected from the bluefish commercial fishery in the Chesapeake Bay. Recommendations for improving the system include:

1) Coordinate finfish license requirements with the needs of finfish catch and effort reports.
2) Reevaluate the reporting form to include information on what types of gear a fishermen owns, how much they used on a particular day, and how much they caught.
3) Develop a check and balance system to validate the catch and effort records.
4) Continue the commercial reporting requirements in Maryland and establish a mandatory reporting system in Virginia.
5) Evaluate how the use of young bluefish in the bait fishery contributes to fishing mortality.

IMPLEMENTATION 3.1.1
1991

ACTION 3.1.2
Maryland, the Potomac River Fisheries Commission, and Virginia will assess methods for improving recreational/charter catch and effort data needed to evaluate the biological and economic impacts of these fisheries. Recommendations include:

1) Evaluate hook and line data collected from the Maryland charter boat industry, i.e., age and length frequency, to characterize the recreational catch in the Bay.
2) Obtain economic information for the recreational and charter fisheries to determine the factors important for sustaining these industries and determining their value to the region.
3) Institute a pilot survey of sportsfishermen in Maryland to obtain catch and effort data for several species, including bluefish.

IMPLEMENTATION 3.1.2
1991

ACTION 3.1.3
Maryland, the Potomac River Fisheries Commission, and Virginia will encourage research to collect data

on bluefish biology, especially estimates of population abundance, mortality, and recruitment in the Chesapeake Bay. Suggested research topics include:

1) Determine the factors that affect bluefish movements and distribution in the Bay.
2) Collect data on length frequency and age composition of both the commercial and recreational bluefish catch.
3) Investigate the environmental parameters that affect reproduction and growth of bluefish.

IMPLEMENTATION 3.1.3
1991

Problem 4 - Habitat and Water Quality Issues: Water quality in the Chesapeake Bay has been impacted by a variety of factors including inadequately treated sewage, nutrients, toxics, and runoff from agricultural and urban lands. These factors affect the living resources in the Bay including bluefish. Toxic contamination of bluefish, especially kepones and PCB's, has been an important issue. Excessive nutrients in the Bay can deplete oxygen, creating anoxic conditions. Anoxia is known to limit the distribution of bluefish.

Strategy 4 - Habitat Issues: Adequate water quality is necessary to insure protection of living resources in Chesapeake Bay. The jurisdictions will continue their efforts to improve water quality and define habitat requirements for the living resources in Chesapeake Bay.

PROBLEM 4.1
Water quality impacts the distribution and abundance of finfish species in the Chesapeake Bay.

STRATEGY 4.1
The District of Columbia, Environmental Protection Agency, Maryland, Pennsylvania, the Potomac River Fisheries Commission, and Virginia will continue to promote the commitments of the 1987 Chesapeake Bay Agreement. The achievement of the Bay commitments will lead to improved water quality and enhanced biological production.

ACTION 4.1
The District of Columbia, Environmental Protection Agency, Maryland, Pennsylvania, the Potomac River Fisheries Commission, and Virginia will continue to set specific objectives for water quality goals and review management programs established under the

1987 Chesapeake Bay Agreement. The Agreement and documents developed pursuant to the Agreement call for:

1) Developing habitat requirements and water quality goals for various finfish species.
2) Developing and adopting basinwide nutrient reduction strategies.
3) Developing and adopting basinwide plans for the reduction and control of toxic substances.
4) Developing and adopting basinwide management measures for conventional pollutants entering the Bay from point and nonpoint sources.
5) Quantifying the impacts and identifying the sources of atmospheric inputs on the Bay system.
6) Developing management strategies to protect and restore wetlands and submerged aquatic vegetation.
7) Managing population growth to minimize adverse impacts to the Bay environment.

IMPLEMENTATION 4.1
Continuing.

CHESAPEAKE BAY
BLUEFISH MANAGEMENT PLAN IMPLEMENTATION

PROBLEM AREA	ACTION	DATE	RESPONSIBLE AGENCY & METHOD	ADDTL STAFF or $$	COMMENTS/NOTES
1. Stock status & increased fishing pressure	1.1.1 Continue to participate in scientific and technical meetings for managing bluefish along the coast and in estuarine waters.	Continue	MDNR - A PRFC - A VMRC - A		Jurisdictions will work closely with the MAFMC, ASMFC, and other coastal states, especially to monitor the commercial catch.
	1.1.2.1 Will adhere to state allociations established by the MAFMC/ASMFC for commercial harvest of bluefish if projected harvest levels meet criteria in the coastal plan.	Dependent on harvest trends	MDNR - A,R PRFC - A,R VMRC - A,R		Bay jurisdictions will coordinate with each other and with federal government. May include gear, trip, area, catch, and/or other restrictions.
	1.1.2.2 Will continue present licensing requirements for harvest and sale; Va will establish a 10 fish creel limit for its commercial hook and line fishery and pursue a license for that fishery.	1991	MDNR - A PRFC - A VMRC - A,R		VA will require new regulation for commercial hook and line fishery.
	1.1.2.3 MD will establish a 10 fish/person/day recreational creel limit. VA & PRFC instituted 10 fish creel limit in summer 1990. Creel limits and minimum legal sizes may be modified as appropriate.	1991	MDNR - R PRFC - R VMRC - R		Will require new regulations. Jurisdictions will coordinate creel limits and size limits.
2. Wasteful harvest practices	2.1.1 A 10 fish daily creel limit (see Action 1.1.2.3) will minimize wastage.	1991	MDNR - R PRFC - R VMRC - R		See Action 1.1.2.2.
	2.1.2 Will educate the general public about the need to reduce the waste problem in the bluefish fishery.	1991	MDNR - A PRFC - A VMRC - A	10K	MD has produced video & fact sheet on hook & release; ASMFC has also developed hook & release brochure. Will explore other means to educate the public about reducing waste.

CHESAPEAKE BAY
BLUEFISH MANAGEMENT PLAN IMPLEMENTATION

PROBLEM AREA	ACTION	DATE	RESPONSIBLE AGENCY & METHOD	ADDTL STAFF or $$	COMMENTS/NOTES
	2.1.3 Will assess factors causing waste in the commercial sector and indentify potential solutions.	1991	MDNR - A PRFC - A VMRC - A	75K	Must look at market demand, bait fishery, migratory patterns, etc. Contractual arrangement likely.
3. Research needs	3.1.1 Will improve the catch and effort data collected from the bluefish commercial fishery in the Chesapeake Bay.	1991	MDNR - A PRFC - A VMRC - A		Will be accomplished in conjunction with other fish species reporting. Need to assess licensing, reporting, and follow up systems. VA will pursue mandatory reporting system.
	3.1.2 Will assess methods for improving recreational & charter catch/effort data needed to evaluate biological & economic impacts.	1991	MDNR - A PRFC - A VMRC - A	40K 40K*	The ASMFC is encouraging states to buy into MRFSS for bluefish; Bay jurisdictions will assess feasibility. Need staff to look at existing biological data and assess economic factors.
	3.1.3 Will encourage research to collect data on bluefish biology.	1991	MDNR - A PRFC - A VMRC - A	100K	Will coordinate with CBSAC, universities, other agencies.
4. Habitat issues	4.1 Will continue to set goals for water quality and habitat, and review programs established under the 1987 Bay Agreement.	Continue	MDNR - A PRFC - A VMRC - A PFC - A EPA - A		Agencies must coordinate closely; must continue work on habitat requirements for bluefish and other water quality issues in the Bay.

LEGEND:
ASMFC = Atlantic States Marine Fisheries Commission
CBSAC = Chesapeake Bay Stock Assessment Committee
EPA = Environmental Protection Agency
MAFMC = Mid-Atlantic Fisheries Management Council
MDNR = Maryland Department of Natural Resources
MRFSS = Marine Recreational Fishery Statistical Survey
PFC = Pennsylvania Fish Commission
PRFC = Potomac River Fisheries Commission
VMRC = Virginia Marine Resouces Commission

A = Administrative action
L = Legislation
R = Regulation
K = $1,000
* = Federal funds