AMENDMENT 1

TO THE

BLUEFISH FISHERY MANAGEMENT PLAN

(Includes Environmental Impact Statement and Regulatory Impact Review)

VOLUME 1

October 1998

Mid-Atlantic Fishery Management Council

and the

Atlantic States Marine Fisheries Commission,

in cooperation with the

National Marine Fisheries Service,

the

New England Fishery Management Council,

and the

South Atlantic Fishery Management Council

Draft adopted by MAFMC: 3 June 1998
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A Publication of the Mid-Atlantic Fishery Management Council pursuant to National Oceanic and Atmospheric Administration Award No. NA57FC0002

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930-2298

JUL 29 1999

Dr. James Gilford
Mid-Atlantic Fishery Management Council
Room 2115 Federal Building
300 South New Street
Dover, Delaware 19901-6790

Dear Jim:

I have partially approved Amendment 1 (Amendment) to the Fishery Management Plan for Atlantic Bluefish.

I have approved the following measures:

- permit and reporting requirements for commercial fishermen, dealers, and party/charter boat operators
- the establishment of a Bluefish Monitoring Committee
- the implementation of a framework adjustment process
- a revision of the overfishing definition for Atlantic bluefish
- a nine year stock rebuilding schedule
- a commercial state quota allocation and
- portions of the definition of Essential Fish Habitat not specifically disapproved below

For the reasons discussed below, I have disapproved:

- the provision which would implement de minimus status for certain states where historical catch is low
- three sections of the essential fish habitat portion, and
- the social impact assessment regarding communities

De Minimus Specifications

The requirement for a de minimus state to monitor the its fishery is vague, with no specific requirement for the state to monitor a fishery on a timely basis. Without specific requirements to track landings in a timely manner, a state could exceed its commercial de minimus quota with no knowledge of the need to close the state fishery since there is no effective way to identify landings relative to the quota, possibly until well after year-end. This creates a loophole that may attract a greater degree of commercial landings than the 0.1% allocation provides for, particularly if other nearby states have reached quota and are closed to further landings. Furthermore, the draft does not appear to identify how overages for de minimus states would be addressed if they were to occur, although it does indicate a state will lose its de minimus status if its exceeds its quota.

In addition, the number of states granted de minimus status could vary on a yearly basis. This could require a recalculation of the entire coastwide commercial quota, since the sum of the allocations to de minimus states would be deducted from the coastwide commercial quota before the remainder is allocated to the other states. Therefore, even if the total quota did not vary, the state by state allocations would change if the number of states granted de minimus status changes. This would result in increased administrative workloads for both state and Federal regulators, as well as public confusion about their state's quota.

The proposed measure to establish de minimus quota specifications is identical to the measure that I disapproved in Scup Amendment 8 and Summer Flounder Amendment 10. Even though I expressed the above concerns to the Council and requested that justification be provided given my previous disapprovals, the Council failed to justify the de minimus measure. The Council has been notified that this measure will not be published in the proposed rule.

Essential Fish Habitat

Adequacy of the Assessment of Fishing Gears Used in Bluefish EFH and their Impacts

The Amendment fails to list and to consider adequately the potential adverse impacts of all fishing gears used in the waters described as EFH, particularly those waters under state jurisdiction. Information on fishing gears used in state waters is readily available from the individual states, or the centralized Atlantic Coastal Cooperative Statistics Program office.

A significant portion of bluefish EFH occurs within state waters and the Council has indicated that there is some linkage between juvenile bluefish and submerged aquatic vegetation (SAV). The studies the Council cites in Table 12 and additional studies that review the impacts of estuarine fishing gears to SAV in Chesapeake Bay indicate that there are impacts to SAV from certain estuarine fishing gear. These gears are not listed in Section 2.2.3.6 (Fishing Gear Used Within the Bluefish Range), their potential impacts to bluefish EFH are not assessed in Section 2.2.3.7 (Fishing Impacts to Bluefish EFH), nor are the measures for managing potential adverse impacts considered in Section 2.2.4 (Options for Managing Adverse Effects from Fishing). These three sections of the Amendment are disapproved.

Social Impact Assessment

The fishing communities section of the amendment is based on the 1993 surveys of the Mid-Atlantic commercial fishing communities by McCay et al. The communities involved in the present day fishery are not sufficiently identified and the amendment does not describe or consider impacts on recreational fishing communities, such as Ocean City, Virginia Beach, or Oregon Inlet. Thus, dependence of communities on the fishery is not assessed or considered, and the requirements of Section 303(a)(9) and National Standard 8 are not satisfied.

Other Matters

Regarding the approved bluefish EFH designation for eggs, we understood the term "mid-shelf depths" to mean be depths of 98 to 230 feet (30-70 meters) based on an article written by Fahay in 1998.

So there is no misunderstanding, the description of the method used to implement state alternatives to the recreational limits in the Amendment does not trigger the need to promulgate Federal regulations regarding these alternatives.

I appreciate the hard work you and your staff have put into developing this Amendment. I look forward to working with you to ensure the plan operates effectively to eliminate overfishing and rebuild the bluefish resource.

Sincerely,

Patricia A. Kurkul
Regional Administrator

UNITED STATES DEPARTMENT OF COMMERCE
Office of the Under Secretary for
Oceans and Atmosphere
Washington, D.C. 20230

JUN 17 1999

Dear Reviewer:

In accordance with the provisions of the National Environmental Policy Act of 1969 (NEPA), we enclose for your review the Final Environmental Impact Statement (FEIS) for Amendment 1 to the Bluefish Fishery Management Plan.

This FEIS is prepared pursuant to NEPA to assess the environmental impacts associated with this action. This amendment is designed to address requirements established by the Sustainable Fisheries Act of 1996. It describes and identifies essential fish habitat for the bluefish fishery, and includes a new overfishing definition and a rebuilding schedule for bluefish. The amendment also proposes operator and vessel permits for commercial and party and charter boats, dealer permits, formation of a Bluefish Monitoring committee, establishment of an annual specification process for a coastwide harvest limit (to be divided into total allowable landing levels (TAL) for the commercial and recreational fisheries), allocation of the annual commercial TAL among states, and a framework adjustment process. A copy of the Biological Opinion for this action may be obtained from the Responsible Official below.

Any written comments on the FEIS should be directed to the responsible official identified below by July 26, 1999.

The National Marine Fisheries Service (NMFS) is not required to respond to comments received as a result of issuance of the FEIS. However, comments will be reviewed and considered for their impact on NMFS' decision.

Responsible Person: Kathi Rodrigues
Senior Fishery Policy Analyst
National Marine Fisheries Service
Northeast Regional Office
One Blackburn Drive
Gloucester, MA 01930-2298

Telephone Number: (907) 281-9300

Sincerely,

Barbara Schreiber for

Susan B. Fruchter
Director, Office of Policy and
Strategic Planning

NOTE:

This Final Environmental Impact Statement incorporates by reference a Biological Opinion on Amendment 1 to the Bluefish Fishery Management Plan. This Biological Opinion discusses issues regarding turtles . For a copy of the Biological Opinion, please contact the Responsible Official below:

Kathi Rodrigues
Senior Fishery Policy Analyst
National Marine Fisheries Service
Northeast Regional Office
One Blackburn Drive
Gloucester, MA 01930-2298

Telephone Number: (907) 281-9300

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EXECUTIVE SUMMARY

Amendment 1 to the Fishery Management Plan for the Bluefish Fishery (FMP), prepared by the Mid-Atlantic Fishery Management Council (Council) and the Atlantic States Marine Fisheries Commission (Commission), is intended to manage the bluefish (*Pomatomus saltatrix*) fishery pursuant under both the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) of 1976, as amended by the Sustainable Fisheries Act (SFA), and the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA). The management unit is bluefish *(Pomatomus saltatrix)* in U.S. waters in the western Atlantic Ocean. The goal of the management plan is to conserve the bluefish resource along the Atlantic coast. The Council and Commission have adopted five major objectives to achieve this goal:

1. Increase understanding of the stock and of the fishery.

2. Provide the highest availability of bluefish to U.S. fishermen while maintaining, within limits, traditional uses of bluefish.

3. Provide for cooperation among the coastal states, the various regional marine fishery management councils, and federal agencies involved along the coast to enhance the management of bluefish throughout its range.

4. Prevent recruitment overfishing.

5. Reduce the waste in both the commercial and recreational fisheries.

Overfishing Definition

The SFA requires that FMP's contain a definition of overfishing which contain status determination criteria comprised of two components: 1) a maximum fishing mortality threshold and 2) a minimum stock size threshold. For bluefish, the maximum F threshold is specified as F_{MSY}, or the fishing mortality rate which produces maximum sustainable yield (MSY). The minimum biomass threshold is specified as ½ the biomass level associated with maximum sustainable yield (B_{MSY}).

Management Strategy

The Council and Commission propose to rebuild the bluefish stock to the B_{MSY} level over a nine year rebuilding period through the implementation of this amendment. The preferred alternative will eliminate overfishing and rebuild the bluefish stock through a graduated reduction in the fishing mortality rate. For the first two years of the rebuilding plan (1999-2000), F will remain at the current level (F=0.51) and then will be reduced to F=0.41 in years 3-5 (2001-2003) and finally to F=0.31 in years 6-9 (2004-2007). During the rebuilding period, the target F for the next fishing year would be set at the level specified in the rate reduction schedule or the level estimated for the most recent year, whichever is less. This schedule would allow for stock rebuilding to the level which would support harvests at or near MSY by the year 2007 or earlier.

Specification of Adopted Management Measures

The following is a summary of the management measures adopted by the Council and Commission to implement this Amendment (a complete description of the proposed management measures is given in section 3.1).

Permits and Fees

The following permits will be required:

1. Operator permits for commercial and party and charter boats.

2. Vessel permits for party and charter boats.

3. Vessel permits for commercial vessels (permit to sell).

4. Dealer permits (permits to purchase).

5. Permitted vessels may only sell to permitted dealers and permitted dealers may only buy from permitted vessels.

6. Party and charter boat, commercial vessel, and dealer reports.

In cases where states already have permit systems in place as called for in this amendment, then the amendment will allow implementation of mechanism consistent with the Atlantic Coastal Cooperative Statistics Program to eliminate duplicate state/federal permits.

Bluefish FMP Monitoring Committee

The Bluefish Monitoring Committee is a joint committee of the Council and Commission that will be made up of staff representatives of the Mid-Atlantic, New England, and South Atlantic Fishery Management Councils, the Northeast Regional Office, the Northeast Fisheries Center, and Commission representatives. The Bluefish Monitoring Committee will annually review the best available data and recommend to the Council Committee and Commission Bluefish Management Board, commercial (annual quota, minimum fish size, and minimum mesh size) and recreational (possession and size limits and seasonal closures) measures designed to assure that the target mortality level for bluefish is not exceeded.

Framework Adjustment Process

In addition to the annual review and modifications to management measures associated with the monitoring committee process, the Council could add or modify management measures through a framework adjustment procedure. This adjustment procedure allows the Council to add or modify management measures through a streamlined public review process. As such, management measures that have been identified in the plan could be implemented or adjusted at any time during the year. The Commission could implement these same modifications through their adaptive management process.

Commercial Management Measures

Commercial fish size limitations and minimum mesh requirement

The minimum fish size and minimum mesh restrictions for otter trawls and gill nets may be implemented according to the Bluefish FMP Monitoring Committee process or the framework adjustment process.

Commercial quota

A quota would be allocated to the commercial fishery to control fishing mortality. The quota would be based on the most recent estimates of stock size coupled with the target fishing mortality rate (which would allow for a calculation of total allowable landings). Based on the historic proportion of commercial and recreational landings for the period 1981-1989, 17% of the total allowable landings (TAL) would be allocated to the commercial fishery. If the commercial quota was less than 10.5 million lbs, the quota could be increased up to 10.5 million lbs if the recreational fishery was not anticipated to land their entire allocation for the upcoming year. A state-by-state system to distribute and manage the annual commercial quota would be implemented by the Council and Commission. Quotas would be distributed to the states based on their percentage share of commercial landings for the period 1981-1989.

De minimus specifications

Any state that has commercial landings less than 0.1% of the total coastwide commercial landings in the last preceding year for which data are available would be eligible for *de minimus*. The *de minimus* specifications only apply to the commercial fishery. Any state granted *de minimus* status would be allocated 0.1% of the coastwide commercial quota. The sum of the allocations to *de minimus* states would be deducted from the coastwide commercial quota before the remainder is allocated to the other states.

Recreational Management Measures

Recreational size, possession and seasonal limits

The recreational fishery throughout the management unit would be managed through an annual evaluation of a framework system of possession limits, size limits, and seasonal closures. The annual recreational possession limit, size limit, and season would be set at a range of between 0 and the maximum allowed by the recreational share of the adopted fishing mortality rate reduction strategy. The current 10 fish possession limit would remain in effect. States could develop and implement alternative recreational management measures that were equivalent to the coastwide measures.

Recreational Harvest Limit

A recreational harvest limit would be allocated to the recreational fishery to reduce exploitation rates on the fully recruited age groups. The harvest limit would be would be based on the most recent estimates of stock size coupled with the target fishing mortality rate (which would allow for a calculation of total allowable landings). Based on the historic proportion of commercial and recreational landings from 1981-1989, 83% of the total allowable landings would be allocated to the recreational fishery.

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1.0 INTRODUCTION

The bluefish fisheries in U.S. waters of the western Atlantic Ocean are managed under the Bluefish Fishery Management Plan (FMP) that was prepared cooperatively by the Mid-Atlantic Fishery Management Council and the Atlantic States Marine Fisheries Commission. The plan was approved by NMFS in March, 1990 and adopted by the Commission in October, 1989. This amendment to the Bluefish FMP was prepared under both the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) of 1976, as amended by the Sustainable Fisheries Act (SFA), and the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA). The MSFCMA requires that the management measures proposed in an FMP be consistent with ten national standards for fishery conservation and management. Under ACFCMA, if a state does not implement management measures required by an FMP or amendment, the federal government may impose a moratorium on the landing of the species covered by the FMP in that state.

FMPs and amendments must meet the requirements of a number of federal laws and regulations. In addition to MSFCMA, these include the National Environmental Policy Act, the Endangered Species Act, the Marine Mammal Protection Act, Executive Order 12866, and the Regulatory Flexibility Act. This document has been developed to meet these federal requirements and contains all elements of the FMP Amendment, Draft Environmental Impact Statement, Regulatory Flexibility Analysis, Regulatory Impact Review, and Fishery Impact Statement.

1.1 PURPOSE AND NEED FOR ACTION

1.1.1 History of FMP Development

During the 1980's, bluefish was consistently one of the top three species most frequently sought by marine recreational fishermen along the Atlantic coast of the United States. In fact, more bluefish (by weight) were landed by anglers coastwide than any other marine fish each year from 1979 to 1987. An increase in the number of marine anglers, an apparent increase in bluefish abundance, and a decline in the abundance of other desired finfish such as striped bass and weakfish during this time period may explain this predominance (Anderson and Almeida 1979). Although most bluefish are harvested by sport fishermen, commercial landings have averaged about 14 million lbs per year since 1981, or approximately 20% of the total bluefish landings along the Atlantic coast.

In the late 1970s, potential markets for bluefish in Africa and South America stimulated tuna purse seiners to consider harvesting bluefish. This interest prompted concerned fishermen to petition the Mid-Atlantic Fishery Management Council (Council) to develop a Fishery Management Plan (FMP) for this species. Seven fact finding meetings were held by the Council in early 1979 to give fishermen from Virginia through New England an opportunity to present information on the bluefish fishery. Public attendance at most of these meetings was exceptional. At every meeting, the desire for the development of a Plan was strongly expressed by the recreational community. As a result, in May, 1979, the Council held a scoping meeting to develop a work plan for the FMP. The work plan was adopted by the Council in July, 1979 and approved by the National Marine Fisheries Service (NMFS) in March, 1980. Additional impetus to FMP development was provided by the 1982 harvest of bluefish by Florida fishermen using runaround gill nets in Chesapeake Bay (SFI 1982).

The Council, in cooperation with the NMFS, New England and South Atlantic Fishery Management Councils, and the Atlantic States Marine Fisheries Commission (Commission), completed a Bluefish FMP in 1984 (MAFMC 1984). The plan was based on an allocation system with recreational fishermen receiving 80% of the total projected bluefish catch each year and the commercial fishery the remaining 20%. Commercial catch was to be further allocated at the rates of 10%, 50%, and 40% to the North Atlantic, the Mid-Atlantic, and South Atlantic subregions, respectively. The difference between the total projected catch for each subregion and the commercial catch in state waters was to be allocated to the commercial fishery in the Exclusive Economic Zone (EEZ).

To serve as the basis of management decisions, the Council, in consultation with the NMFS, planned to submit catch projections each year to NMFS. If catch projections for any user group/area equaled or exceeded 90% of the user group/area allocation, the Regional Director of NMFS could have instituted control measures such as trip limits, individual vessel quotas, time limits, and/or gear limitations. Also, the Regional Director could have closed the commercial fishery in any area of the EEZ to vessels using non-traditional gear (that is, gear other than hook and line, conventional gill nets, and otter trawls) when 80% of the allowable commercial harvest in the EEZ of that area had been caught by such vessels. Furthermore, the 1984 plan would have established a data collection system, based on permits and logbooks, to facilitate operation of the management system.

However, the 1984 Council bluefish plan was rejected by the Secretary of Commerce for the following reasons:

1. The regulatory actions in the FMP were not based upon adequate information concerning the need for and the consequences of proposed action. As such, the regulatory impacts were not quantified as to benefits compared to cost.

2. There was no immediate urgency for management at the time.

3. The measures in the plan did not prevent overfishing since they applied only to commercial fishing in federal waters.

4. The allocation system of the plan was too rigidly fixed and complex and did not allow for changes in various areas over time.

5. There was a question of fairness in the plan with regard to treatment of different areas and between traditional and non-traditional fishing gear.

Although the 1984 Plan was rejected, bluefish remained a major value to the nation and public concerns about bluefish overexploitation were not abated. Subsequently, the Fishery Management Councils and the Commission agreed to proceed jointly on the development of a new bluefish management plan containing compatible management measures that could be enacted in both state and federal waters. This cooperative venture represented a new approach for managing interjurisdictional fisheries.

The current bluefish management plan was prepared cooperatively by the by the Mid-Atlantic Fishery Management Council and the Atlantic States Marine Fisheries Commission. The FMP was adopted by the Commission at its annual meeting 2 - 5 October 1989. The FMP was adopted by the Council 26 October 1989 and by NMFS 20 March 1990 . The management measures adopted in the FMP included a license requirement for any person selling a bluefish. In addition to this, anglers were restricted to a possession limit of no more than ten bluefish, or less if the state of landing has a more stringent possession limit. On vessels with several passengers, the number of bluefish contained on the vessel may not exceed ten (or the adjusted limit) 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 pooled catch and in their possession at all times. Commercial hook and line fishermen may take more than the possession limit if they have a commercial permit to sell bluefish.

Without a permit, fishermen using hook and line gear are restricted to the possession limit. Based on a recommendation by the Council and Commission, the Regional Administrator, and the Atlantic states in their respective jurisdictions, may modify the possession limit to between 0 and 15 bluefish per angler. 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 a two tier approach. If the increase in commercial landings is attributed to the use of a highly efficient gear (purse seines, pair trawls, or runaround gill nets), then the highly efficient gear responsible for the increase in commercial landings will be regulated for the taking of bluefish in EEZ waters. Regulations considered include trip limits, area closures or restrictions, and other measures that may be appropriate, including gear prohibitions. The Bluefish FMP Review and Monitoring Committees (section 3.1.1.6), annually review landing statistics to determine if commercial controls will be implemented.

In 1996, the Council and Commission began development of Amendment 1 to the 1990 Bluefish FMP. Because the Bluefish FMP has a limited number of management options to control fishing mortality, the Council and Commission identified the need to broaden the suite of management measures that could be used to reduce fishing mortality on the bluefish stock. In addition, the amendment was developed to meet the requirements of the Sustainable Fisheries Act (SFA) that was enacted in October, 1996.

1.1.2 Problems for Resolution

1.1.2.1 Additional management measures are necessary for the recreational fishery

The only management measure for the recreational fishery specified in the current FMP is a possession limit, which may be set from 0 to 15 bluefish. Since this is the only tool currently available to manage the recreational fishery, an extremely low possession limit could be required to achieve the reductions in exploitation necessary to reduce fishing mortality.

Other measures to control fishing mortality in the recreational bluefish fishery should be considered, including minimum fish size limits and seasons. Additional management measures for the recreational fishery would give managers more flexibility in controlling fishing mortality. In addition, a combination of these measures might allow achievement of fishing mortality rate targets while minimizing the negative impacts on fishermen relative to a possession limit alone.

1.1.2.2 Additional management measures are necessary for the commercial fishery

The FMP currently manages the commercial fishery through a state-by-state quota system only if the commercial catch is projected to exceed 20% of the total catch. If the increase in commercial landings is attributed to the use of a highly efficient gear (purse seines, pair trawls, or runaround gill nets), then the highly efficient gear responsible for the increase in commercial landings would be regulated for the taking of bluefish in EEZ waters. This amendment to the Bluefish FMP considers alternative ways of allocating quotas both among the states and various sectors of the fishery. The Council and Commission also seek to decouple commercial quotas from the recreational catch. As a result, alternative quota allocation systems are considered in this amendment.

The current FMP lacks management measures which control size of bluefish harvested by commercial fisheries. As such, additional commercial measures which are considered include minimum size limits, mesh size restrictions, and other measures that may be appropriate (including gear prohibitions). If these additional management measures are added to the program, the fishing mortality targets will be achieved with less impact on the fishery than management based solely on a quota. In addition, gear restrictions such as minimum mesh regulations could be necessary to reduce discards.

1.1.3 Management Objectives

The major goal of the management plan is to conserve the bluefish resource along the Atlantic coast. The Council and Commission have adopted five major objectives to achieve this goal:

1. Increase understanding of the stock and of the fishery.

2. Provide the highest availability of bluefish to U.S. fishermen while maintaining, within limits, traditional uses of bluefish.

3. Provide for cooperation among the coastal states, the various regional marine fishery management councils, and federal agencies involved along the coast to enhance the management of bluefish throughout its range.

4. Prevent recruitment overfishing.

5. Reduce the waste in both the commercial and recreational fisheries.

1.1.4 Management Unit

The management unit is bluefish (*Pomatomus saltatrix*) in U.S. waters of the western Atlantic Ocean.

1.1.5 Management Strategy

The Sustainable Fisheries Act (SFA), which reauthorized and amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), made a number of changes to the existing National Standards. With respect to National Standard 1, the SFA imposed new requirements concerning definitions of overfishing in fishery management plans. To comply with National Standard 1, the SFA requires that each Council FMP define overfishing as a rate or level of fishing mortality that jeopardizes a fisheries capacity to produce maximum sustainable yield (MSY) on a continuing basis.

Each FMP must specify objective and measurable status determination criteria for identifying when stocks or stock complexes covered by the FMP are overfished. To fulfill the requirements of the SFA, status determination criteria for bluefish are comprised of two components: 1) a maximum fishing mortality threshold and 2) a minimum stock size threshold. The maximum F threshold for bluefish is specified as F_{MSY}. The minimum biomass threshold is specified as ½ B_{MSY}.

For bluefish, maximum sustained yield (MSY), the fishing mortality rate at MSY (F_{MSY}), and the biomass that produces MSY in the long-term (B_{MSY}) were most recently estimated by Gibson and Lazar (1998a) using a surplus production model. F_{MSY} was estimated to be 0.4 and B_{MSY} was estimated to be 237 million lbs (107,500 mt). These values form the basis of the definition of overfishing for bluefish. The fishing mortality rate threshold is defined as $F_{MSY}=0.4$ and the minimum stock biomass is defined as ½ B_{MSY} or 118.5 million lbs (53,750 mt).

An additional requirement of the SFA is that stocks which are identified as overfished (i.e., stock biomass is less than minimum biomass threshold) must rebuilt to the level that will produce maximum sustainable yield (B_{MSY}). The SFA guidelines advise that, in most cases, the stock rebuilding period may not exceed 10 years. The most recent stock assessment data presented by Gibson and Lazar (1998a) indicate that total bluefish stock biomass is currently about 55.12 million lbs (25,000 mt), well below the minimum stock biomass threshold of 118.5 million lbs (53,750 mt). As a result, the Council and Commission propose to rebuild the bluefish stock to the B_{MSY} level over a nine year rebuilding period through the implementation of this amendment.

The preferred alternative will eliminate overfishing and rebuild the bluefish stock through a graduated step reduction in fishing mortality rate. For the first two years of the rebuilding plan (1999-2000), F will remain at the current level (F=0.51) and then will be reduced to F=0.41 in years 3-5 (2001-2003) and finally to F=0.31 in years 6-9 (2004-2007). During the rebuilding period, the target F for the next fishing year would be set at the level specified in the rate reduction schedule or the level estimated for the most recent year, whichever is less. This schedule allows for stock rebuilding to the level which will support harvests at or near MSY in the year 2007 or earlier.

1.2 PROPOSED AND ALTERNATIVE MANAGEMENT MEASURES

1.2.1 Proposed Management Measures

The Council and Commission are proposing a number of management measures to meet the objectives of the amendment (a complete description of these management measures is given in section 3.1). These preferred alternatives are as follows:

1. Permit and reporting requirements for commercial fishermen, dealers, and party/charter boat operators.

2. The establishment of a Bluefish FMP Monitoring Committee.

3. The implementation of a framework adjustment process.

4. A nine year stock rebuilding schedule.

5. Commercial fish size limitations and minimum mesh requirements.

6. A commercial quota with state allocations.

7. *De minimus* specifications for the commercial quota.

8. Recreational size, possession, and seasonal limits.

9. A recreational harvest limit.

1.2.2 Management Action Alternatives

A number of alternatives to the proposed management measures have been identified by the Council and Commission for consideration by the public (a complete description of these management measures is given in section 3.1). These alternatives include:

1. Take no action at this time.

2. The use of alternative landings years to allocate the commercial quota and recreational harvest limit.

3. A coastwide commercial quota with coastwide trip limits.

4. The use of alternative years to allocate the commercial quota to the states.

5. A coastwide trip limit system in conjunction with a state by state quota system.

6. A maximum size limit in the commercial fishery.

7. The use of a temporary allocation system that allows commercial harvest to stay constant until recreational landings increase.

8. Alternative rebuilding schedules.

2.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

2.1 DESCRIPTION OF THE STOCK

2.1.1 Species Description and Distribution

Bluefish and *Pomatomus saltatrix* are the accepted common and scientific names for the species, respectively (AFS 1991). Bluefish are also known as blue, tailor, snapper, elf, fatback, snap mackerel, skipjack, snapping mackerel, horse mackerel, greenfish, skip mackerel, chopper, and Hatteras blue (Wilk 1977, Oliver *et al.* 1989, Pottern *et al.* 1989).

The bluefish body is elongate, robust, and moderately compressed, with the belly compressed to a bluntish edge. The coloration is bluish or greenish above and silvery below with a blackish blotch at the base of the pectoral (Jordan and Evermann 1896). Bluefish may attain ages of 11 or 12 years and can exceed 3 feet in length. The official rod and reel record is 31 pounds, 12 ounces for a bluefish caught off Cape Hatteras, North Carolina, in 1972 (IGFA 1997). A bluefish weighing 45 pounds was reportedly caught off the African coast (Anderson 1978).

Bluefish are a migratory, pelagic species generally found in continental shelf waters in temperate and semi-tropical oceans around the world with the exception of the north and central Pacific. In North America, bluefish range from Nova Scotia to Florida in the northwestern Atlantic and also occur in the Gulf of Mexico from Florida to Texas. Tagging studies and other information indicate a significant degree of separation between bluefish in the northwestern Atlantic and bluefish in the Gulf of Mexico (Lyman 1974, Wilk 1977), although some intermingling may occur (Miller 1969). Distribution of the fish and fisheries by season and area support the theory of separate Atlantic and Gulf of Mexico populations, as does the discovery of a separate bluefish spawning area in the Gulf (Barger *et al.* 1978, Finucane *et al.* 1980, Ditty and Shaw 1995). Tagging studies and ichthyoplankton surveys have helped to establish the location of spawning areas and migration routes (Clark *et al.* 1969, Lund and Maltezos 1970, Norcross *et al.* 1974, Wilk 1977, Kendall and Walford 1979, Pottern *et al.* 1989).

A recent genetic study suggests that bluefish along the Atlantic coast comprise a single stock (Graves *et al.* 1992). The authors analyzed 472 young-of-year and yearling bluefish collected in New Jersey, Virginia, and North Carolina over a three-year period. Despite considerable variation in mitochondrial DNA within samples, no significant genetic differentiation was detected among spring-spawned and summer-spawned young-of-year and yearling bluefish from different geographic locations along the mid-Atlantic coast, or from yearling bluefish collected at the same location in different years.

Previously, bluefish were thought to spawn in two principal areas along the Atlantic coast, one in the South Atlantic Bight, the other in the Mid-Atlantic Bight (Lassiter 1962, Kendall and Walford 1979). Several studies have reported small but consistent morphological differences between these two major spawning aggregations (Wilk 1977, Lund and Maltezos 1970). However, a recent long-term study (Smith *et al.* 1994) of bluefish egg and larval distribution in the Northeast Continental Shelf Ecosystem concludes that spawning occurs as a protracted season which begins in late winter in slope waters off the southeast United States and progresses northward with time. Studies by Hare and Cowen (1993, 1994, and 1995) support the continuous spawning hypothesis by analysis of gonosomatic indices, larval otoliths (a granule of calcium carbonate in vertebrate inner ear), larval abundances, and larval distributions from both the South and Mid-Atlantic Bights (Hare and Cowen 1993, 1994, 1995). Modeling of large-scale ocean circulation off the U.S. east coast, assuming a continuous spawning hypothesis, predicts that bluefish spawned in the middle of a protracted spawning season would have a lower probability of recruitment, thus creating the observed pattern of bimodal recruitment (Hare and Cowen 1993). Additional support for the single stock hypothesis was generated by Chiarella and Conover (1990), who determined that summer-spawning fish off New York originated from spring-spawned juveniles, suggesting that summer and spring spawning stocks are not distinct and that most contemporary stocks of Atlantic coast bluefish may consist of spring-spawned fish. Additional studies may be required to definitively determine which of the competing hypotheses (two distinct spawning aggregations versus one sequential one) is more correct.

Bluefish spawning in the South Atlantic Bight occurs on the shoreward edge of the Gulf Stream. Larvae from spring spawning drift north of Cape Hatteras in the Gulf Stream and spread out along the continental slope of the Mid-Atlantic Bight (Kendall and Walford 1979). These young bluefish enter shelf waters and estuaries in mid-June as waters warm, remain in estuaries during the summer, and migrate south along the coast in early fall. Larvae from later spawning in the South Atlantic move to inshore waters south of Cape Hatteras. In the mid-Atlantic Bight, spawning begins in continental shelf waters in June, peaks in July, and continues into August with larvae inhabiting estuaries or nearshore waters before migrating south in the fall (Norcross *et al.* 1974, Kendall and Walford 1979, Smith *et al.* 1979). The temporal distribution of young bluefish in oceanic and estuarine waters may differ from year to year (Norcross *et al.* 1974).

In general, adult bluefish travel northward in spring and summer, and southward in fall and winter. Tagging studies indicate the southerly migration route may be closer to shore than the northerly migration in spring, and both migration periods are characterized by some offshore-inshore movement (Wilk 1977). Temperature and photoperiod are the principal factors directing activity and distribution (Olla and Studholme 1971, 1972) with bluefish migrations triggered by water temperatures between 54-59 °F (Lund and Maltezos 1970). During summer, bluefish stocks are centered between Cape Cod and Chesapeake Bay and in the northern part of North Carolina. The summer range of bluefish tends to shift further north as the fish increase in size and age (Wilk 1977). Although the exact distribution of bluefish during winter is unknown, it is possible that a large portion of the population remain on the outer continental shelf, far offshore during this period (Hamer 1959, Lund and Maltezos 1970).

Bluefish migrate in groups of like sized fish which in turn form loose aggregations which may extend over large areas of ocean surface (Wilk 1977). Freeman and Turner (1977) observed three migrating groups of bluefish offshore of New Jersey: an inshore contingent (bluefish 1-3 pounds), mid-shelf contingent (bluefish 3-10 pounds), and an offshore contingent (bluefish 6 pounds and greater). The number of fish exhibiting schooling behavior may be greater by day than by night (Olla and Studholme 1972, 1979). Hydrographic features such as changing thermal gradients, cold cells, and frontal systems (Olla *et al.* 1985), as well as anoxic water (Freeman and Turner 1977) may act as migration barriers. Changes in tides, weather, season, and prey may explain localized migrations into bays and ocean inlets (Wilk 1977).

Temperature is probably the single most important environmental parameter determining bluefish distribution, migration, feeding, spawning, and recruitment success (Lund and Maltezos 1970, Pottern *et al.* 1989). Thermal studies performed in a large (120,000-gallon) aquarium indicated that adult bluefish swim continuously both day and night at an acclimation temperature of 64-72 °F (Olla and Studholme 1975, Olla *et al.* 1975). Temperatures above or below this range produced increased cruising speeds during day and night. At upper and lower extreme "stress" temperatures, bluefish swam constantly at high speeds and showed little interest in food. Bluefish respond to either high or low temperature extremes with avoidance behavior (Olla and Studholme 1979) and temperature preference varies with size and season. Juveniles inhabit water at temperatures between 64-79 °F during summer (Wilk and Silverman 1976), but are found at temperatures between 59-63 °F in fall (Kendall and Walford 1979). Adult bluefish are generally found in water with a surface temperature of 64-74 °F but have been caught in water temperatures as low as 48 °F and as high as 86 °F (MAFMC 1984). Thermal preferences may, in part, explain distributional differences between juvenile and adult fish.

Bluefish can withstand a wide range of salinities. Experimental work conducted at the Oceanographic Research Institute, Durban, South Africa, indicated juvenile bluefish tolerated salinities from 19.5 ppt to 35 ppt and adults from 9 ppt to 48.5 ppt (van der Elst 1976). Lippson and Lippson (1984) indicate that bluefish may ascend well into estuaries where salinities may be less than 10 ppt. Pottern *et al.* (1989) consider the species to be moderately euryhaline (moderately tolerant of a wide range of salinities).

Bluefish are strong swimmers and have several other adaptations which help explain why they are a circum-global species (species which occurs in all world oceans). Adult bluefish which swam against water currents in a laboratory could maintain speeds of 4.0 to 4.6 body lengths per second for 30 minutes or more (Oliver *et al.* 1989). They can shift to ram gill ventilation at intermediate and high velocities, transferring the workload of breathing from the gill musculature to the body muscles and thereby saving energy (Freadman 1979). Turbulence does not reduce their maximum swimming speed (Ogilvy and Dubois 1981). They can secrete gas into their swim bladders at the fastest rate known for any fish, which allows them to rapidly change depth over a large range (Bentley and Wiley 1982).

Fishes which are adapted to pelagic (open ocean) conditions are usually not well-adapted for low oxygen conditions (Pottern *et al.* 1989). Several instances have been observed where bluefish avoided areas with low dissolved oxygen concentrations. Adult bluefish were absent from areas of the New York Bight with depressed oxygen concentrations during the summer (Azarovitz *et al.* 1979, Swanson and Sinderman 1979). Small bluefish preying on spawning Atlantic silversides (*Menidia menidia*), which were in waters with less than 1 mg/l oxygen came no closer than waters with 4 mg/l concentration (Middaugh *et al.* 1981). A study of the effects of low dissolved oxygen on finfish and lobster in western Long Island Sound (Howell and Simpson 1994) indicated that bluefish were among the species most sensitive to hypoxia (a deficiency of oxygen the tissues of the body). The authors examined the relationship between catch and bottom dissolved oxygen in terms of abundance, numbers of species and mean length for trawl sites throughout the sound, and determined that declines in abundance and diversity occurred when dissolved oxygen levels decreased below 2 mg/l.

Occurrence and abundance of bluefish varies annually in specific areas off the Atlantic coast due to seasonal migrations (Freeman *et al.* In prep.). Bluefish are found from Nova Scotia to northern New England from June-October with a peak in August and September. They occur from April to December from southern New England to the Mid-Atlantic states with a peak abundance between July and October. In South Atlantic waters, bluefish occur year round during most years. Commercial landings data compiled by NOAA/FDA/EPA (1986) indicated that most bluefish were caught in North Carolina waters between December and March. Off the east coast of Florida, peak landings occurred in January.

2.1.2 Abundance and Present Condition

Because year class strength of Atlantic coast bluefish is highly variable (Boreman 1983), the development of an accurate pre-recruitment index is important for effective management. Boreman (1983) concluded that the catch per tow of bluefish in the NMFS fall inshore survey north of Cape May appeared to be an adequate index of recruitment based on a correlation between this index and commercial and recreational harvests 2 to 4 years later. A later study (Crecco *et al.* 1987, USDC 1987a) found a significant positive correlation ($r=0.87$, $P<0.001$) between the 1979-1986 mean juvenile indices from the NMFS fall inshore survey (the 1974-1986 geometric mean catch per tow of juvenile bluefish from Cape Cod to Cape Hatteras) and the corresponding mean catch per unit effort (CPUE) indices of juvenile bluefish from the coastwide shore fishery (MAFMC 1990a). However, because of the variability associated with year to year catches of age 1 and older bluefish in the survey and trends in recruitment indicated by the MRFSS data (NOAA 1988), the juvenile indices from the NMFS trawl survey may be biased. Despite this and other limitations of the NMFS survey (for example, the survey does not sample bluefish from the South Atlantic), Crecco *et al.* (1987) assumed that the 1974-1986 juvenile indices from the fall survey accurately measured bluefish recruitment from Cape Hatteras to Cape Cod. These indices indicated that bluefish year class recruitment north of Cape Hatteras was highly variable with no evidence of a systematic decline in year class strength from 1974 to 1986 and that three strong year classes had been produced at irregular intervals, one each in 1977, 1981 and 1984 (Crecco *et al.* 1987, NOAA 1987).

Recruitment of bluefish in recent years was summarized in the report of the latest Stock Assessment Workshop (SAW) (National Oceanic and Atmospheric Administration, hereafter NOAA, 1997a-b). Recruitment of bluefish is determined through trawl surveys conducted by the National Marine Fisheries Service, as noted above, and supplemented by those of the states. Surveys presently used are the Northeast Fishery Science Center fall bottom trawl survey, conducted from Nova Scotia to Cape Hatteras; Connecticut Department of Environmental Protection fall bottom trawl survey in Long Island Sound; Rhode Island Division of Fish and Wildlife fall survey in Narragansett Bay; New York Department of Environmental Conservation Hudson River beach seine survey; New Jersey Bureau of Marine Fisheries beach seine and otter trawl surveys; Delaware Division of Fish and Wildlife bottom trawl survey; Maryland Department of Natural Resources seine survey; Virginia Institute of Marine Science juvenile fish trawl survey; and North Carolina juvenile fish trawl surveys. Most of these surveys agreed that the best year classes were recruited in 1981, 1984, 1989 and 1994. Since 1984, only two strong year classes were produced, in 1989 and 1994. Low values were recorded in all other years, and the 1993 value was the lowest on record (NOAA 1997b).

Based on most assessments undertaken since preparation of the original plan (MAFMC 1990a), the stock appears to be at a low level of abundance and over-exploited (Kline *et al.* 1994, NOAA 1994a-b, Gibson 1995, Bluefish Plan Review Team 1996, Christian 1996, NOAA 1997a-b). In 1994, the Atlantic States Marine Fisheries Commission and Mid-Atlantic Fishery Management Council reported that the stock was considered to be over-exploited and at a low level of abundance, noting that recreational catch levels were about 25% of the catch level of the early 1980's; that fully-recruited fishing mortality rates (F) had increased from about 0.2 in 1982 to about 0.45 in 1993; F values had been above F_{MSY} since at least 1986; stock biomass had decreased by about 77% from 1982 to 1993, and recruitment since 1989 had been below average.

Gibson (1995) conducted an assessment using tagging data, survey indices, and a mass-balance approach and reached the same conclusion, stating that F in 1994 was estimated at 0.68. He concluded that the stock had been overfished since 1979 and that the steep decline in stock biomass which occurred since 1980 was associated with high F from 1983 to 1989. Low stock levels were also associated with weak recruitment. Gibson noted that his analysis depended heavily on the tag-based F estimates, and that if tag loss was higher than the corrections made, or not representative of the entire stock, the results would be biased. His analysis also assumed that the National Marine Fisheries Service, Northeast Fishery Science Center fall trawl survey is an unbiased estimator of stock abundance. If bluefish have moved offshore, outside of the survey area, the analysis would have additional bias.

The Atlantic States Marine Fisheries Commission Bluefish Plan Review Team reported in 1996 that the stock was still considered over-exploited and at a low level of abundance for the period in which recreational catch and survey abundance indices were available (1974-1994). Their report reiterated the concerns expressed in Gibson (1995).

The Stock Assessment Workshop 23 (NOAA 1997a-b) also concluded that the stock was at a low level of abundance and was over-exploited. The SAW 23 report indicated that current recreational catches of 26.5 million lbs were about 20% of the level of the early 1980's and that fully-recruited F rates increased from 0.12 (10% exploitation) in 1988 to 0.51 (36% exploitation) in 1992.

The most recent assessment of the bluefish stock was conducted by Gibson and Lazar (1998a) using a biomass dynamic model (See Appendix for the complete assessment). This assessment has been reviewed and accepted by the Mid-Atlantic Fishery Management Council's Scientific and Statistical Committee. Gibson and Lazar concluded that bluefish biomass has fallen to low levels in association with fishing rates well in excess of F_{MSY}. Accepting $F_{MSY} = 0.40$ from the biomass dynamic model as an overfishing definition, bluefish have been overfished since 1979 (Table 1).

The biomass dynamic model estimated the F rates to be highly variable since 1979. The highest F rates of 0.93 and 0.94 were estimated in 1987 and 1991, respectively (Table 1). Recent estimates of the F rate have moderated to near F_{MSY}, with an F rate of 0.51 in 1997. The biomass dynamic model results contrast with the SAW 23 results which show a rising fishing mortality in recent years. The biomass dynamic model results are similar to tag results from Gibson and Lazar (1996). They estimated an $F=0.72$ during the late 1960s which increased to $F=0.93$ during the late 1980s.

The decline in fishing mortality rates since 1991 coincides with the implementation of management measures, as well as a decline in angler interest for bluefish. The Bluefish FMP was approved in 1990 and fully implemented by the states in 1991. The FMP required a 10 fish possession limit or equivalent recreational measures and also instituted a process to establish commercial quotas. These management measures may have had significant effects on fishing mortality. In addition, MRFSS data for 1991 and 1996 indicate a switch in angler preference from bluefish to striped bass over the time period. For example, in 1991, 34% and 11% of the anglers interviewed identified bluefish and striped bass, respectively, as the primary species sought on their fishing trip. In 1996, the percentages switched with 12% and 44% of the anglers identifying bluefish and striped bass, respectively, as the primary species.

Also, there is some evidence to suggest that the current observed decline in bluefish may be due in part to factors in addition to over-exploitation (Moore 1996a). Both Crecco (1996a-b) and Terceiro (1996) have conducted preliminary investigations of such factors. As Terceiro (1996) notes:

> "The abundance of Atlantic coast bluefish has shown a steady decline since the early 1980's (NEFSC 1994 [NOAA 1994b]; this assessment, NEFSC In prep. [NOAA 1997b]). Bluefish recruitment has been below the long-term (1982-1995) average since 1990. The age structure of the stock has not been severely truncated, however, and the fishing mortality rate (F) has not risen to the extreme levels (>1.0) usually associated with dramatic stock declines. Fully recruited F for bluefish has ranged between 0.1 and 0.5 since 1982 (this assessment, ICA analysis). Therefore, the sequence of very high F leading to low spawning stock biomass (SSB) and subsequent low recruitment may not have occurred for Atlantic coast bluefish. Instead, other factors (environmental effects, interactions with competitors, interactions with prey) may have caused a period of poor recruitment success over the last decade, with a subsequent decline in SSB and a slow rise in F, as catches declined more slowly that stock size."

Crecco (1996a-b) has investigated the evidence of offshore displacement of Atlantic coast bluefish based on commercial and recreational landings. The observed decline in recreational bluefish landings which has occurred since 1987 could be explained, in part, if there was a tendency for older (age 2+) bluefish to migrate offshore (>3 miles). Such a migration could occur due either to recent changes in oceanic conditions, or perhaps in response to the dramatic rise in abundance of striped bass in nearshore areas. Since most (70-80%) of the recreational fishing trips along the Atlantic coast occur within 3 miles of shore, steady dispersion of adult bluefish from inshore to offshore waters since 1988 could explain the drop in recreational landings. Crecco (1996b) examined the trends in bluefish commercial landings, fishing effort, and CPUE by statistical zones from 1982 through 1994 to test the hypothesis that a portion of the Atlantic coast bluefish stock has recently migrated offshore. The analysis documented that: bluefish commercial landings have remained steady from 1976-1993; the percent of commercial landings from the EEZ (3-200 miles) rose steadily from 1976-1981, stabilized, and then rose again to a peak in 1993, while coastal (0-3 miles) landings declined to zero in 1992-1993; the percentage of bluefish commercial landings from inshore statistical zones (1-10 miles) has remained steady since 1988, while the percentage from offshore areas (11-100 miles) has increased from 3.4% in 1981 to a peak of 23.2% and remained high. This apparent shift in commercial landings from state to federal waters suggests that some portion of the stock may have recently migrated further offshore. Additional analysis of the effort data show that effort in offshore areas has also shifted from nearshore to offshore areas. There is also a significant positive correlation between the rise in striped bass abundance from nearshore areas and the percentage of bluefish landings coming from the EEZ. Although the total evidence is rather limited, the observations support the hypothesis that a part of the stock, at least north of Virginia, has recently migrated offshore (Crecco 1996b).

Terceiro (1996) noted that bluefish abundance in the northwest Atlantic has been documented historically to fluctuate between periods of great abundance and noted scarcity since the 1600's (Bigelow and Schroeder 1953). Notable disappearance of bluefish from areas north of Cape Cod has occurred in the late 1700's, late 1800's, early 1900's and early 1940's (Bigelow and Schroeder 1953). Such fluctuations are assumed to be due to factors other than extreme fishing mortality, such as: environmental factors that influence recruitment success; environmental factors which cause changes in the distribution of the adult stock; changes in the abundance of prey species which influence recruitment success or adult distribution; and competition with other species (e.g. striped bass) for common prey, which also could affect recruitment or adult distribution (Terceiro 1996).

Both Crecco *et al.* (1987) and Munch (MS In prep.) provide evidence that bluefish recruitment is related to prevailing winds during spring. Crecco *et al.* (1987) found significant correlations between March winds north of Cape Hatteras, North carolina and estimates of bluefish recruitment. Munch (MS In prep.) found a significant correlation between the abundance of the spring-spawned cohort of bluefish as indexed by the Northeast Fisheries Science Center fall trawl survey and April wind speed and direction over the waters of southern New England and Long Island, New York. In both analyses, the mechanism proposed is that strong northeast winds (blowing toward the southwest) in the spring expedite the onshore migration of larval or juvenile bluefish to estuarine nursery grounds (Terceiro 1996).

Terceiro (1996) performed analyses which compared several series of biological and environmental data with trends in bluefish recruitment and spawning stock biomass. Environmental parameters included Mid-Atlantic Bight sea surface temperature anomalies, 1968-1995, and an index of April wind speed and direction off the New England coast, 1974-1995. Biological data were estimates of Chesapeake Bay striped bass SSB and recruitment, 1968-1995 and abundance indices for sand lance, bay anchovy, striped anchovy, *Loligo* squid, *Illex* squid, butterfish, Atlantic silverside, American shad, blueback herring, Atlantic mackerel (age-1 abundance and SSB), Atlantic herring (age-1 and SSB), and Atlantic menhaden (age-1 and SSB). Age 0 bluefish abundance and indices of bluefish egg density were also used as variables. The analysis indicated numerous correlations, both positive and negative. For example, bluefish and sand lance abundance were positively correlated, and there were inverse correlations between bluefish and striped bass, herring and sand lance, mackerel and sand lance, and striped bass and river herring. Without further testing and analysis, there is no way to tell whether any causal relationships underly these correlations. Terceiro (1996) suggests that additional parameters should be tested and more complex analyses be undertaken.

Gibson and Lazar (1998a) concluded that the biomass declined dramatically from 1979 to 1994 and has increased since 1994 (Table 1). The biomass dynamic model estimated that the biomass that is needed to produce maximum sustainable yield is 237 million lbs (107,500 mt). The current estimate of biomass is well below the biomass associated with MSY and is estimated in 1998 at 55.12 million lbs (25,000 mt). This biomass represents about 23% of the biomass associated with MSY.

2.1.3 Ecological Relationships and Stock Characteristics

2.1.3.1 Spawning and early life history

Most bluefish are sexually mature by age 2 (Deuel 1964a), although ovaries mature at a slightly slower rate than testes in bluefish of similar size (Wilk 1977). The overall sex ratio for bluefish sampled from recreational and commercial fisheries, 1963 to 1968, was 1:1 with approximately equal numbers of males and females present at all ages (Wilk 1977). The sex of bluefish cannot be determined externally and there may be some tendency for sexes to school together (van der Elst 1976). Morse (cited in Boreman 1983) found a linear relationship between size of female bluefish and the number of eggs they contained. The equation describing this relationship, for bluefish 22 to 32" in fork length (FL), was:

$$\text{Fecundity (000's)} = -5063.11 + 297.6(FL)$$

This relationship substantiates information from other studies (Lassiter 1962, van der Elst 1976, Wilk 1977, Finucane and Collins MS) that indicate bluefish are a highly fecund species. Females weighing 4.2 to 5.9 lbs contained 600,000 to 1.4 million eggs (Lassiter 1962).

Spawning occurs in offshore spawning areas principally from April to May in southern waters and June through August in the Middle Atlantic Bight (Kendall and Walford 1979). Debate is still ongoing as to whether there are two separate and distinct spawning aggregations, or whether spawning proceeds sequentially from south to north (Smith *et al.* 1994). Temperature and salinity are the principal factors directing spawning activity; optimum temperature and salinity for spawning in the Mid-Atlantic Bight were 78 °F and 31 ppt (Norcross *et al.* 1974, Kendall and Walford 1979, Smith 1980). Minimum temperature and salinity at which spawning occurred in these waters was 64 °F at 31.7 ppt and 69 °F at 26.6 ppt (Norcross *et al.* 1974).

Fertilization of bluefish eggs is external. Eggs are pelagic and highly buoyant with hatching and early larval development occurring in oceanic waters. Surveys indicate the greatest abundance of bluefish eggs and larvae appear on the outer part of the continental shelf more than 30 nautical miles from shore (Deuel *et al.* 1966, Norcross *et al.* 1974).

Fertilized bluefish eggs hatch in 48 hours at temperatures between 68 to 70 °F. Larvae are strongly associated with the surface and have been sampled during every season of the year in offshore waters from Cape Cod, Massachusetts to Palm Beach, Florida (Kendall and Walford 1979). However, an intensive sampling program conducted by the Northeast Fisheries Science Center, collected only two bluefish larvae in offshore waters during spring, 1988 (USDC 1988). Larval development takes place in outer continental shelf waters within 6 meters of the surface at temperatures of 64-79 °C and salinities of 30-32 ppt (Kendall and Walford 1979). Larvae do undertake daily vertical migrations, concentrating at depths around 4 meters during noon and at the surface at night (Kendall and Naplin 1981). Bluefish larvae are rarely found in near-shore waters, although recently hatched larvae have been collected in both the lower Chesapeake Bay (Pearson 1950) and in Narragansett Bay (Herman 1963).

Larval concentrations in spring off the South Atlantic region were greatest off New River, North Carolina and Charleston, South Carolina, near the outer edge of the continental shelf (Kendall and Walford 1979). Some authors believe these larvae apparently are carried northward past Cape Hatteras by the Gulf Stream in April and May and dispersed over the continental slope of the Mid-Atlantic region (Kendall and Walford 1979, Smith 1980). Others presented evidence for southward and seaward migration of bluefish larvae that came from spring spawning in the South Atlantic Bight (Collins and Stender 1987). Larvae from fall and winter spawning in southern waters may find their way inshore south of Cape Hatteras, as indicated by the presence of a few juveniles there during winter (Kendall and Walford 1979, Powles 1981).

Concentrations of larvae in summer were high on the continental shelf of the Mid-Atlantic region (Morse *et al.* 1987). Larvae spawned in the Mid-Atlantic region remain offshore until late summer and then apparently move southward in the fall.

As the season progresses, young-of-year bluefish move inshore with estuaries serving as the chief habitat during the juvenile life stage (Kendall and Walford 1979). Juvenile bluefish spawned in southern waters in spring grow to 8" in length by fall, whereas those spawned in summer are approximately 2-3" by fall. Spawning patterns and growth rates explain the distinct size groups of juvenile bluefish, or snappers, caught concurrently in the fall by anglers along the Middle Atlantic and Northeast coasts, that is, fish in 2-4 and 6-10" ranges (Sargeant and Boreman 1984). Most young-of-the-year bluefish in New York waters come from the spring spawning area (Nyman and Conover 1987). Bluefish spawned in the Mid-Atlantic Bight in summer appear in North Carolina sounds the following spring at a TL of 10" and may remain in the sounds through summer averaging 13-14" TL by fall.

Migration of spring-spawned young-of-the-year bluefish into northern estuaries at an advanced size appears to facilitate predation on local inshore fishes which become their principal prey (Juanes *et al.* 1993, Juanes and Conover 1994a, 1994b, Juanes *et al.* 1994, Juanes and Conover 1995, Marks and Conover 1993). Evidence gathered from early-juvenile bluefish collected from continental shelf waters indicates that the transition from crustacean to fish prey occurs offshore, prior to onshore migration (Marks and Conover 1993). The predominant spring-spawned cohort of bluefish is thought to result from spawning in the South Atlantic Bight in March and April, advection northward along the edges of the Gulf Stream, and active migration by juveniles into New Jersey and New York estuaries in June and July (Nyman and Conover 1987, McBride and Conover 1991, McBride *et al.* 1993, McBride *et al.* 1995). Summer-spawned juveniles are believed to recruit to inshore areas in August. Hypotheses were tested by studying young-of-year bluefish in Great South Bay, New York, and Narragansett Bay, Rhode Island. Recruitment was shown to coincide with the appearance of Atlantic silversides (*Menidia menidia*), their primary prey. Young-of-year bluefish in the Hudson River estuary fed largely on juvenile anadromous fish, including striped bass, blueback herring, and American shad (Juanes *et al.* 1993). The young bluefish also fed primarily on the most abundant prey available and were size selective, consistently ingesting small prey sizes (Juanes and Conover 1994a). These results suggest that transport into high latitudes permits spring-spawned bluefish to exploit habitats at an earlier time and at a larger size than would otherwise be possible (Juanes and Conover 1995). Spring-spawned bluefish dominated catches and were about twice as large as summer-spawned fish by October (McBride *et al.* 1995). This strategy also allows bluefish to accelerate the shift to a fish diet by timing their arrival to coincide with the appearance of small coastal fishes and juvenile anadromous ones.

A study of juvenile bluefish captured in Maine estuaries indicated that the major bluefish spawning areas should either be expanded to the northeast, or that unknown spawning areas exist closer to Maine (Creaser and Perkins 1994). Juvenile bluefish collected from several sites (Marsh River, Sagadahoc Bay) were aged by counting daily otolith growth rings. Birth dates corresponded to hatching dates in spring (Marsh River) and summer (Sagadahoc Bay), but the authors believe that the time required to swim from the known South and Mid-Atlantic Bight spawning areas was too great to presume that the fish originated there.

2.1.3.2 Age and growth

The effects of temperature, salinity, and fish size on growth and feeding of juvenile bluefish were examined by Buckel *et al.* (1995). Feeding and growth rates of juveniles increased with increasing temperature and decreased with increasing fish size in short-term (1 week) experiments. Salinity had no effect in short-term experiments on growth or feeding. In long-term trials (3 months), feeding and growth rates declined with increasing body size. Juvenile bluefish have rapid growth and their individual cumulative consumption is large, which suggests that bluefish may have a large effect on their prey populations (Buckel *et al.* 1995).

Bluefish length-age data have been reported by Wilk (1977), Richards (1976), and several state agencies along the Atlantic coast (New Hampshire Game and Fish, Connecticut Department of Environmental Protection, Maryland Department of Natural Resources, North Carolina Division of Marine Fisheries). These studies indicate that mean lengths (TL inches) for Atlantic coast bluefish more than doubled between ages 1 to 4, and the rate of growth then declined steadily thereafter (Table 2). Lengths at age 1 usually ranged from 9.3 to 11.1", whereas the lengths at age 2, when most bluefish are sexually mature (Wilk 1977), generally ranged from 14.9 to 20.1" TL. The growth rates of older (greater than age 5) bluefish not only declined with age, but were often more variable than those of younger bluefish. Bluefish over age 8 were rare in all samples; the 1982-1985 North Carolina data contained the only fish age 9 and older with a mean back-calculated length for age 11, the oldest bluefish aged in any study, of 37.0" TL.

Length-age data available from the separate studies were fit to the von Bertalanffy growth equation:

$$L_t = L_{inf} (1 - e^{-K(t - t_0)})$$

where: L_t is mean fork length (in) at age, L_{inf} is theoretical maximum length, K is the rate at which L_t approaches L_{inf}, t_0 is the age at zero length, and t is the age of the fish (years). The L_{inf} (asymptotic size) estimates for the separate studies ranged from 35.3 to 40.9" TL and the K values from 0.216 to 0.373 (Table 3).

2.1.3.3 Length-weight relationship

Length-weight relationships have been developed for bluefish in several studies (Hamer 1959, Lassiter 1962, Richards 1976, Wilk 1977, Barger MS). Wilk *et al.* (1978) found that age specific weight increments did not differ significantly between male and female bluefish collected in the New York Bight. However, extreme variability in the weight of bluefish of similar lengths has been reported (Hamer 1959). Wilk (1977) developed a length-weight relationship from over 7500 bluefish collected coastwide between 1963 and 1968:

$$W = (7.323 \times 10^{-4}) \times FL^{2.855}$$

where: W is weight (lbs) and FL is fork length (in).

2.1.3.4 Mortality

The instantaneous natural mortality rate (M) is defined as annual losses experienced by adult bluefish from all natural and anthropogenic (induced or altered by the presence and activities of man) factors except commercial and recreational fishing. The indirect methods of Pauly (1980) and Hoenig (1983) were used to estimate M for adult (age 1 and older) bluefish (Crecco *et al.* 1987). Hoenig (1983) related published natural mortality rates (M) to the maximum age (t_{max}) of 84 fish stocks, from which he developed the following predictive equation:

$$\log_e (M) = 1.46 - 1.01 \log_e (t_{max})$$

Based on a maximum age (t_{max}) of 11 or 12 years for bluefish results in M values of 0.38 and 0.35, respectively.

An estimate of M was also derived using Pauly's (1980) multiple regression equation, which incorporates the von Bertalanffy growth parameters (L_{inf}, K) and the mean water temperature (T) within which adult bluefish commonly occur. Based on growth parameters derived by Wilk (1979), as well as a range of water temperatures in which bluefish are commonly found (54-64 °F), the estimated M values ranged from 0.32 to 0.39. In the absence of any additional information, these methods indicate that 0.35 is a reasonable estimate of M for age 1 and older bluefish.

Crecco *et al.* (1987) derived an average instantaneous natural mortality rate (M) of 2.6 for juvenile bluefish (age 0) using Pauly's method (1980). This rate is equivalent to a monthly mortality rate of 25%. Although the accuracy of M (2.6) for age 0 bluefish is difficult to assess, this monthly estimate (25%/month) is within the range of monthly mortality rates reported for several juvenile fishes including American shad, *Alosa sapidissma*, (34%/month) (Crecco *et al.* 1983), winter flounder, *Psuedopleuronectes americanus* (30%/month) (Pearcy 1962), Atlantic herring, *Clupea harengus*, (36%/month) (Dragesund 1969), European plaice, *Pleuronectes platessa*, (20%/month) (Bannister *et al.* 1974), and striped bass, *Morone saxatilis* (36%/month) (Dey 1981).

Due to data limitations, catch curve analysis (Gulland 1983) was the only method available in 1987 to estimate total mortality rates for bluefish. Thus, total mortality rates (Z) for adult bluefish (age 1 and older) were estimated using catch curve analysis and age composition data for bluefish collected from a Connecticut trawl survey and a New Jersey recreational survey. In addition, data collected from sport fish surveys conducted in Delaware Bay and New York and commercial data from North Carolina were aged using the coastwide age-length key to derive mortality estimates.

Estimates of total mortality (Z) from the fisheries dependent and independent data generally ranged from 0.6 to 0.8 (MAFMC 1990a). Instantaneous fishing mortality rates (F) were estimated by subtracting a natural mortality rate of 0.35 from these Z values. Age frequencies (ages 1-8) from the Connecticut trawl survey provided instantaneous fishing rates (F) between 0.24 and 0.52 (MAFMC 1990a). These fishing rates were similar to those from the North Carolina winter trawl fishery in 1983, 1984, 1986, and 1987 but are much higher than the F value (0.087) in 1985. Based on associated coefficients of variability, Crecco *et al.* (1987) determined that this value of F (0.087) for 1985 was less reliable than the other estimates. In addition, the derived fishing mortality rates for bluefish collected in New York, New Jersey, and Delaware Bay, were within the range of values estimated from the other data sets.

An average F from all data sets was 0.347 (+ 0.027). Although this estimate may be biased due to changes in recruitment, catchability, and availability of bluefish from year to year, no additional data or methodology existed to refute or corroborate this value. This suggested that the best estimate of the fishing mortality rate on adult bluefish for 1987 was approximately 0.35 (assuming an M value of 0.35 also).

At Stock Assessment Workshop 17 (NOAA 1994a), the Stock Assessment Review Committee (SARC) suggested that values of M in the range of 0.2 to 0.25 might be more appropriate than the 0.35 value employed in earlier assessments. The SARC concluded that a value of M = 0.25 is consistent with the observed maximum age of 12 for bluefish.

More recently, Gibson and Lazar (1998a) used the biomass dynamic model to estimate stock sizes and estimate fishing mortality for Atlantic Bluefish. The fishing mortality rates of age 0 and older bluefish ranged from 0.32 to 0.94 during the years 1974 to 1997 (Table 1). The fishing mortality peaked in 1991 (0.94) and steadily decreased through 1997 (0.51).

2.1.3.5 Food and feeding

The results of several studies suggest that bluefish juveniles and adults eat whatever taxa are locally abundant (Table 18; Fahay 1998). The components of bluefish young-of-the-year diet in

Sandy Hook Bay, New Jersey and the effects of those components on bluefish condition were studied over a three-year period (Friedland *et al.* 1988). This study found that fishes dominated the diet during 1981, while crustaceans and polychaetes were more important during 1983 and 1984. Weight-length relationships then indicated that weight at length was significantly greater in 1981 than in the other two study years. Thus, not only does the quality of diet differ between estuaries, but the method of foraging might also differ, with more benthic foraging evident in Sandy Hook than in those sampled in other estuaries, e.g. Delaware (Grant 1962) or North Carolina (Lassiter 1962). Depending on age class, diets might change through a season. In Chesapeake Bay, diets of three age classes differed through the summer (Table 4), but all three concentrated on menhaden (*Brevoortia tyrannus*) in the fall (Hartman and Brandt 1995a). Cannibalism has only rarely been reported, but occurs in Age 1 and older year classes in North Carolina (Lassiter 1962), and bluefish comprise a minor component in bluefish diets studied during NEFSC bottom trawl surveys on the continental shelf (Fahay 1998).

Bluefish are voracious carnivores that feed on a wide variety of pelagic and demersal fish and invertebrates. At least 70 species of fish have been found in bluefish stomachs including butterfish (*Peprilus triacanthus*), alewife (*Alosa pseduharengus*), menhaden, round herring (*Etrmeus teres*), sand lance (*Ammodytes sp.*), silverside (*Menidia sp.*), Atlantic mackerel (*Scomber scombrus*), anchovy (Engraulidae), Spanish sardine (*Sardinella aurita*), gizzard shad (*Dorosoma cepedianum*), weakfish (*Cynoscion regalis*), rainbow smelt (*Osmerus eperlanus*; Buckley 1989), silver hake (*Merluccius bilinearis*), spotted sea trout (*Cynoscion nebulosus*), Atlantic croaker (*Micropongias undulatus*), sea lamprey (*Petromyzon marinus*), and spot (*Leiostomus xanthurus;* Hildebrand and Schroeder 1928, Klima and Tabb 1959, Grant 1962, Deuel 1964b, Richards 1976, Wilk 1977, Wilk 1979, Naughton and Saloman 1984, Miltner *et al.* 1995). Invertebrates eaten by bluefish include shrimp, lobster, squid, crab, annelid worms, and surf clams (Richards 1976, McCluskey 1977, Wilk 1977, Freeman and Turner 1977). Bluefish attacks on sea birds (French 1981) and humans (de Sylva 1974) have also been documented.

Bluefish have shearing dentition that allow them to ingest part of prey items (Baird 1873, Goode 1879, Bigelow and Schroeder 1953, Mahoney 1972, de Sylva 1974, Smale and Kok 1983). This feeding behavior increases the maximum size of prey available to bluefish and also favors schooling behavior since incapacitated prey are available to other feeding individuals (Smale and Kok 1983).

Ontogenetic changes (based on visible morphological characteristics and not necessarily indicative of natural evolutionary relationships) in prey species and prey size selection have been documented for bluefish (Naughton and Saloman 1984, Smale 1984). In South African waters, bluefish less than 4" in length consumed principally small Crustacea less than 20% of body length whereas those greater than 4" consumed primarily fish 30-50% of body length (Smale and Kok 1983, Smale 1984). Juvenile bluefish in the Hudson River fed on bay anchovy (*Anchoa mitchili*), white perch (*Morone americana*), American shad (*Alosa sapidissima*), river herring (*Alosa spp.*), striped bass (*Morone saxatilis;* Texas Instruments 1976), and Atlantic tomcod (*Microgadus tomcod*; Juanes *et al.* 1993). Predation by age 0 bluefish may represent a substantial source of mortality for age 0 anadromous fishes in the Hudson River estuary (Juanes *et al.* 1993). In fact, initial findings of studies funded by New York Sea Grant and the Hudson River Foundation indicate that the mortality of juvenile striped bass can be attributed largely to bluefish predation (Hogan 1994). Juvenile winter flounder (*Pseudopleuronectes americanus*) have also been observed in stomachs of juvenile bluefish (Greely 1939). Juvenile bluefish in Maine waters consumed mysids and copepods (fish from Sagadohoc Bay, 1.5-2.5 in. [37-64 mm] FL), and fish and large crustaceans (Marsh River fish, 3-8 in. [81-200 mm] FL; Creaser and Perkins 1994).

Diet of juvenile bluefish from Sandy Hook Bay, New Jersey, was determined by Friedland *et al.*

(1988) for the years 1981, 1983, and 1984. The fish consumed a variety of polychaete, crustacean, and fish prey. In terms of biomass and frequency of occurrence, opossum shrimp (*Neomysis americana*), sand shrimp (*Crangon septemspinosa*), grass shrimp (*Palaemonetes vulgaris*), bay anchovy, striped killifish (*Fundulus majalis*), and Atlantic silverside (*Menidia menidia*) dominated the diet. Consumption of invertebrate and fish prey varied between years. Condition factor was higher in years when fish were the dominant prey.

Recent studies by Hartman and Brandt (1995a-c) have examined the competition, dietary overlap and growth of bluefish as compared to weakfish and striped bass in the Chesapeake Bay. Diets of the three species were defined and compared across seasons and by age. Bluefish often had higher dietary overlap values with striped bass and weakfish than with other bluefish cohorts. During May through June, nearly all predator cohorts fed on benthic prey. Most production of all three species was supported by Atlantic menhaden and bay anchovy (Hartman and Brandt 1995b). Of the three species, bluefish came closest to achieving their demand for prey, suggesting that they are more successful predators than either striped bass or weakfish (Hartman and Brandt 1995c). These results suggest that Chesapeake Bay may be a better nursery than production area for older fish, and that prey supply (not temperature) may account for the movements and use of the estuary by older piscivores. Size-specific rates of consumption and metabolism were similar for bluefish and weakfish and higher than those for striped bass (Hartman and Brandt 1995b). The growth physiology of the three species appeared related to water temperatures encountered during estuarine residency and production.

Bluefish respond to olfactory stimuli but rely primarily on vision to locate and capture prey. In addition, Olla *et al.* (1970) found satiated bluefish could be stimulated to resume feeding if offered larger prey items, indicating prey size is an important factor in feeding motivation.

2.1.3.6 Predators and competitors

Bluefish were found in stomach samples collected from blue sharks (*Prionae gleuca;* Kohler and Stillwell 1981), swordfish (*Xiphias gladias;* Stillwell and Kohler 1985), and other bluefish (Lassiter 1962, Richards 1976, Wilk 1977, Naughton and Saloman 1984). Also, it is probable that bluefish are preyed upon by other large piscivores such as tunas *(Thunnus spp.)* and wahoo (*Acanthocybium solanderi;* Wilk 1977). Large bluefish have been successfully used as bait in the bluefin tuna fishery which developed off the North Carolina Outer Banks in recent years (Currin pers. comm. 1997). Based on stomach samples that indicated bluefish was the major food item (77.5% of stomach contents by volume) of shortfin mako *(Isurus oxyrinchus)*, Stillwell and Kohler (1982) estimated these sharks consumed 5,108 to 17,021 tons of bluefish each year in an area between Cape Hatteras and Georges Bank in the Atlantic ocean.

Bluefish share common food resources with striped bass (ASMFC 1988), weakfish (ASMFC 1986), Spanish mackerel, spotted seatrout (*Cynoscion nebulosus*), and various jacks (Carangidae) and mackerels (Scombridae) (Fay *et al.* 1983, Manooch 1984), including king mackerel (Wilk 1977).

Bluefish may compete with common terns for prey fish (Safina and Burger 1985) and in fact may drive seasonal patterns of prey abundance and distribution in New York waters (Safina and Burger 1989). Safina and Burger (1989) used sonar to measure relative abundance, location, and depth of prey fish schools (primarily anchovies and sand lance) in the Atlantic Ocean near Fire Island Inlet. Prey numbers increased through May, peaked in June, and thereafter declined, coinciding with the arrival of bluefish. Bluefish abundance and feeding behavior correlated inversely with prey fish abundance and depth. Juvenile bluefish are preyed upon by common terns (*Sterna hirundo*; Safina *et al.* 1990). The presence and foraging activities of bluefish differentially affect the foraging success of roseate (*Sterna dougallii*) and common terns, with roseate terns being adversely affected (Safina 1990a-b). Safina (1990a-b) considered bluefish keystone competitors with the terns.

2.1.3.7 Parasites, diseases, injuries and abnormalities

Anderson (1970) prepared an annotated list of parasites found in bluefish along the Atlantic coast of the United States. Newman *et al.* (1972) reported on the bacterial flora of the bluefish intestine. Meyers *et al.* (1977) found myxosporidian parasites, *Henneguya* sp., in hearts of bluefish collected in the Atlantic from New York, New Jersey, and Maryland waters. Fin rot disease was noted in bluefish sampled in the New York Bight (Mahoney *et al.*, 1973) and Hickey and Austin (1974) reported pugheadedness in two bluefish specimens collected in Long Island Sound.

A recent study found that a parasitic isopod (*Lironeca ovalis*) which attaches to the gills of young-of-year bluefish was found to have a small but significant effect on the growth of the species in the Hudson River estuary (Marks *et al.* 1996). Prevalence of the parasite on bluefish was high (25.4%) for fish between 75 and 175 millimeters. Parasitized fish weighed 3% less than nonparasitized fish at a given length. The physiological cost of infection appeared to be small and probably does not constitute a serious threat to individual bluefish survival (Marks *et al.* 1996). An earlier study (Landau *et al.* 1995) conducted in Ocean County, New Jersey, found a similar percentage infection (24%), but found no significant difference in the size of parasitized and nonparasitized fish or the slopes of growth regression lines.

A parasite which resides in the ovary of bluefish has been documented in the Mediterranean Sea (Abdulla and Howege 1992). The nematode *Philometra globiceps* was present in 61.2 and 72.6 %, respectively, of female bluefish taken during the 1986 and 1987 fishing season. Although there was no indication of damage to the ovaries from the presence of the parasite, follow-up studies were recommended to determine if bluefish fecundity was affected.

Bluefish in the Tar-Pamlico River estuary in North Carolina exhibited epidemic dermatological disease (Noga *et al.* 1991). Lesions resembling ulcerative mycosis, an infection associated with oomycete fungi which affects Atlantic menhaden, were found on bluefish. The relationship of the observed lesions to environmental problems in the Tar-Pamlico ecosystem is unknown at this time.

2.1.4 Maximum Sustainable Yield

Maximum sustainable yield (MSY) was estimated for Atlantic coast bluefish in several studies. Anderson and Almeida (1979) used a generalized stock production model to derive estimates of MSY that ranged from 189 to 203 million lbs. This estimate was based on data from the NMFS fall offshore survey, reported commercial landings, and the estimated recreational catch.

In a subsequent analysis, the identical methodology was used to derive an estimate of MSY of between 90 and 119 million lbs (Anderson 1980). This analysis differed from the previous assessment in that estimated recreational landings were halved to account for a possible overestimate in the original catch estimates from the 1960, 1965, and 1970 recreational survey.

Boreman (1983) modified the analysis of Anderson (1980) by incorporating several changes in the data base. These included two additional years of data and revised estimates of recreational catch. Derived estimates of MSY ranged from 133 to 143 million lbs.

Because the NMFS fall offshore survey seemed to be selective for larger, older fish (greater than 22 in.), Boreman (1983) assumed the survey did not measure the relative abundance of all age groups in the stock. Thus, he assumed his, and previous estimates of MSY by Anderson and Almeida (1979) and Anderson (1980), were biased. As an alternative, he based MSY on a value that represented a median recruitment level. Because of a correlation between the stratified mean catch per tow from the NMFS fall inshore survey, and commercial and recreational harvest 2 to 4 years later, Boreman (1983) used median catch levels for the years 1960 to 1982 to reflect recruitment. The median catch level, and thus MSY, was 123 million lbs if the original 1960, 1965, and 1970 recreational survey estimates were correct and 93 million lbs if the recreational catch was overestimated by 100%. Based on this methodology, and catches from 1979 to 1987, MSY would be approximately 145 million lbs.

In an attempt to overcome some of the difficulties associated with the previous assessments, Crecco *et al.* (1987) used a steady state yield model derived by Shepherd (1982) to determine MSY and the fishing rates that maximize yield and ensure surplus production to the spawning population. This approach predicts long-term average yields by combining the results of yield-per-recruit and biomass-per-recruit analyses with the stock-recruitment characteristics of the stock. The results of this equilibrium modeling suggested that highest sustainable yields for Atlantic coast bluefish range from 137 to 150 million lbs.

Because virtual population analysis (VPA) was subsequently rejected as a valid technique for estimating stock size (NOAA 1987, 1988), the original data base used by Crecco *et al.* (1987) was modified using the NMFS fall survey to obtain stock recruitment data (Crecco pers. comm.). Revised estimates were similar to previous values and ranged from 142 to 150 million lbs.

Based on this assessment, as well as the update of Boreman's (1983) method, it's probable that MSY ranges from 140 to 150 million lbs. Since 1979, total catch (commercial landings and recreational catch) exceeded 140 million lbs six times, each year from 1979 to 1983 and also in 1986. The catch exceeded 150 million lbs in 1979, 1980, and 1983.

The assessment conducted by Crecco *et al.* (1987), and the subsequent modification, indicated that highest sustainable yields would occur at fishing mortality rates (F) of between 0.3 and 0.4. The participants at the 5th Stock Assessment Workshop (NOAA 1987) concurred with these estimates. These results were substantiated by a yield-per-recruit analysis that indicated $F_{0.1}$ for Atlantic coast bluefish was equal to 0.31 (Terceiro 1987). However, these biological reference points are dependent on values of natural mortality (M), and any uncertainty associated with M would be reflected in these estimates. In the absence of additional data, this information coupled with best estimates of F (0.35) at the time suggested that the stock was fully exploited and that it would be unwise to allow fishing rates on bluefish to exceed 0.4 for more than a few years.

Furthermore, this modeling approach (Crecco *et al.* 1987 and subsequent modifications) predicted a sharp decline in sustainable yield and recruitment if fishing rates (F) exceeded 0.5 for extended periods. In addition, the bluefish stock collapsed completely if F increased beyond 0.6. The reason for the collapse at high F values (F greater than 0.5) is that long-term recruitment drops rapidly as spawning stock biomass is depleted, so that recruitment cannot replace the heavy losses to the adult stock.

Using a biomass dynamic model, Gibson and Lazar (1998a) estimated a maximum sustainable yield of just 94.14 million lbs (42,700 mt) can be produced by the Atlantic bluefish stock when the biomass is at 237 million lbs (107,500 mt). The model results indicated that the maximum sustainable yield could be produced with F rates around 0.4, which is consistent with the previous stock assessments.

2.1.5 Probable Future Condition

Estimated mortality rates (M=0.35, F=0.35) used for the 1987 assessment were combined with relative abundance of age 0 bluefish from the NMFS fall inshore survey to predict future relative population sizes of adult bluefish (MAFMC 1990a). These extrapolations indicated that high population levels of bluefish in the 1980's were supported by the strong year classes in 1981 and 1984, and, to a lesser extent, the 1977 year class. In fact, the estimated catch per unit effort (number/trip) for bluefish derived from MRFSS data trended downward after 1981, reflecting a decline in bluefish abundance. CPUE values in 1988 were less than half the value calculated for 1987. In addition, recruitment was low in 1986 and 1987, and the 1988 value was the lowest on record at that time. These data suggested that without the production of a strong year class in 1989, the population would likely continue to decline into the 1990s.

Despite the fact that the 1989 year class was relatively good, the predictions of the 1987 and subsequent assessments have been accurate, and declines have continued. Gibson and Lazar (1998b) used a biomass dynamic model to make populations projections in the short-term (4-years) and the medium-term (9 years). All of the projections by Gibson and Lazar (1998) assume that the fishing mortality rate will remain at 1997 levels (F=0.51) in 1998. The projections were run so that in the terminal year the biomass would reach the biomass associated with MSY (237 million lbs or 107,500 mt). The first scenario predicted that a constant F rate of 0.36 would rebuild the bluefish stock to biomass at MSY in 9 years. A constant F=0.36 represents a 31% reduction in F from the 1997 level (F=0.51). Under this scenario, landings could gradually increase from 27.87 million lbs (12,642 mt) to levels close to MSY (91.23 million lbs or 41,381 mt) in year 9.

The second projection was configured so that the total biomass of bluefish would reach B_{MSY}, the biomass at MSY, in 9 years by applying a step reduction in fishing mortality. The model predicts that the bluefish stock will recover to a sustainable biomass by maintaining the 1997 fishing mortality rate (F=0.51) for 2 years, followed by F=0.41(21% reduction) for 3 years, then a final reduction to F=0.31 for 4 years. This scenario predicts a modest increase in landings (36.84 million lbs or 16,710 mt - 43.08 million lbs or 19,541 mt) during the first two years; by year 5, the landings would increase to about 59.72 million lbs (27,088 mt). During the final reduction in fishing mortality (years 6-9), the landings would increase to 81.15 million lbs (36,809 mt).

The biomass dynamic model was also used to project the reductions in fishing mortality that would be needed to rebuild in 5 years. If the F rate was reduced to 0.23, the stock would reach B_{MSY} in 5 years. This would allow the landings to increase to 60.63 million lbs (27,501 mt) by year 5. A four step reduction in F was also proposed to rebuild to a sustainable level in 5 years. The F rates would be set at 0.40 in year 1, 0.25 in year 2, 0.18 in years 3, and 0.13 in year 5. This would produce landing of about 36.46 million lbs (16,538 mt) in year 5.

The rebuilding scenarios are based on the results of the biomass dynamics model and, as such, assume that the productivity of the stock will be the same for the projected years as it was for the years used in the assessment (1974 to 1997). If recruitment is lower than anticipated, the stock projections are optimistic. Alternatively, if recruitment is higher than the stock will rebuild at a faster rate.

2.2 DESCRIPTION OF HABITAT

Bluefish are a migratory, pelagic species generally found in continental shelf waters in temperate and semi-tropical oceans around the world with the exception of the north and central Pacific (Figure 1). In North America, bluefish range from Nova Scotia to Florida in the northwestern

Atlantic and also occur in the Gulf of Mexico from Florida to Texas. The management unit for this FMP covers the Atlantic Ocean from Key West, Maine through Florida.

Both the biomass (Table 1) and total catch (Figure 2) of bluefish (commercial landings plus recreational catch) peaked in the late 1970s and early 1980s and have declined since. According to the NMFS' *Report to Congress: Status of the Fisheries of the United States* (September 1997), bluefish are overfished.

Most bluefish are mature by age 2. It is not known whether individuals spawn serially or what the contributions of individuals are to the observed spawning patterns of the population (Fahay 1998). Bluefish may live to age 12.

It is presently believed that there are two spawning events along the east coast of the US, largely based on observations of a bimodal size distribution of young-of-the-year during the summer in the New York Bight (Fahay 1998). As a result of these two spawning events, young are referred to as the "spring cohort" or "summer cohort" in the habitat discussion.

Climate, physiographic, and hydrographic differences separate the Atlantic ocean from the Gulf of Maine to Florida into two distinct areas, the New England-Middle Atlantic Area and the South Atlantic Area, with the natural division occurring at Cape Hatteras. These differences result in major zoogeographic faunal changes at Cape Hatteras. The New England region from Nantucket Shoals to the Gulf of Maine includes Georges Bank, one of the worlds most productive fishing grounds. The Gulf of Maine is a deep cold water basin, partially sealed off from the open Atlantic by Georges and Browns Banks, which fall off sharply into the continental shelf.

The New England-Middle Atlantic area is fairly uniform physically and is influenced by many large coastal rivers and estuarine areas including Chesapeake Bay, the largest estuary in the United States, Narragansett Bay, Long Island Sound, the Hudson River, Delaware Bay, and the nearly continuous band of estuaries behind the barrier beaches from southern Long Island to Virginia. The southern edge of the region includes the estuarine complex of Currituck, Albemarle, and Pamlico Sounds, a 2500 square mile system of large interconnecting sounds behind the Outer Banks of North Carolina.

The South Atlantic region is characterized by three long crescent shaped embayments, demarcated by four prominent points of land: Cape Hatteras, Cape Lookout, and Cape Fear in North Carolina, and Cape Romain in South Carolina. Low barrier islands occur along the coast south of Cape Hatteras with concomitant sounds that are only a mile or two wide. These barriers become a series of large irregularly shaped islands along the coast of Georgia and South Carolina separated from the mainland by one of the largest coastal salt-water marsh areas in the world. Similarly, a series of islands border the Atlantic coast of Florida. These barriers are separated in the north by broad estuaries which are usually deep and continuous with large coastal rivers, and in the south by narrow, shallow lagoons.

The continental shelf (characterized by water less than 650 feet in depth) extends seaward approximately 120 miles off Cape Cod, narrows gradually to 70 miles off New Jersey, and is 20 miles wide at Cape Hatteras. South of Cape Hatteras, the shelf widens to 80 miles near the Georgia-Florida border, narrows to 35 miles off Cape Canaveral, Florida and is 10 miles or less off the southeast coast of Florida and the Florida Keys. The shelf is at its narrowest, reaching seaward only 1.5 miles, off West Palm Beach, Florida.

Surface circulation is generally southwesterly on the continental shelf during all seasons of the year, although this may be interrupted by coastal indrafting and some reversal of flow at the northern and southern extremities of the area. There may be a shoreward component to this drift during the warm half of the year and an offshore component during the cold half. The direction of this drift, fundamentally the result of temperature-salinity distribution, is largely determined by the wind. A persistent bottom drift at speeds of tenths of nautical miles per day extends from beyond mid-shelf toward the coast and eventually into the estuaries.

Water temperatures range from less than 33 °F in the New York Bight in February to over 80 °F off Cape Hatteras in August. The vertical thermal gradient is minimized during winter. In late April to early May, a thermocline develops in shelf waters except over Nantucket Shoals where storm surges retard thermocline development. The thermocline persists through the summer until surface waters begin to cool in early autumn. By mid-November, surface to bottom temperature along the shelf is nearly homogeneous.

Coastwide, an annual salinity cycle occurs as the result of freshwater stream flow and the intrusion of slope water from offshore. Water salinities nearshore average 32 ppt, increase to 34-35 ppt along the shelf edge, and exceed 36.5 ppt along the main lines of the Gulf stream.

The remainder of this habitat section (2.2) is organized to closely follow the outline of section 600.815 which is the mandatory contents of FMPs.

2.2.1 Habitat Requirements by Life History Stage

According to section 600.815 (a)(2)(i)(A), an initial inventory of available environmental and fisheries data sources relevant to the managed species should be used in describing and identifying essential fish habitat (EFH).

In section 600.815 (a)(2)(i)(B), in order to identify EFH, basic information is needed on current and historic stock size, the geographic range of the managed species, the habitat requirements by life history stage, and the distribution and characteristics of those habitats. The worldwide distribution of bluefish is shown in Figure 1, while the total U.S. catches are depicted in Figure 2. Bluefish habitat requirements by life history stage are presented in Table 5 from the bluefish EFH background document (Fahay 1998).

The following information on eggs, larvae, pelagic-juveniles, juveniles, and adult relative abundance in sections 2.2.1.1 through 2.2.1.5 is taken directly from the document "Materials for Determining Habitat Requirements of Bluefish, *Pomatomus saltatrix*" (Fahay 1998). This Fahay (1998) document is referred to hereafter as the bluefish EFH background document. Most of the Tables and Figures from Fahay (1998) are included in this FMP; however, some very specific information, such as graphically depicted monthly ichthyoplankton distribution, is not included in this FMP. This Fahay (1998) bluefish EFH background document is currently being modified for publication by NMFS and can be obtained in its entirety from NMFS, Sandy Hook Laboratory, 74 McGruder Road, Highlands, New Jersey 07732.

2.2.1.1 Eggs

Distribution (spatial & temporal)
Spring-spawned cohort: No information. The spring spawning occurs near the edge of the continental shelf in the South Atlantic Bight (SAB). However, bluefish eggs have not been collected or identified from this region.

Summer-spawned cohort: (Figure 3). Eggs were collected from May through August over the Middle Atlantic Bight (MAB) continental shelf during the eleven-year Marine Resource Monitoring, Assessment and Prediction program (MARMAP) and were most abundant in July. Eggs were distributed near Cape Hatteras in May, and their occurrences expanded rapidly northward during the summer. In July, eggs were distributed as far as southern New England waters with a center of abundance off Delaware Bay and New Jersey (Berrien and Sibunka, in press). Eggs were absent after August.

Relative Abundance & Density
In MARMAP sampling 1977-1987, eggs occurred across the entire shelf but were most concentrated in mid-shelf depths (Berrien and Sibunka, in press). In another study, most (80%) eggs collected off the Chesapeake Bay mouth were >34 miles (55 km) from shore (Norcross *et al.* 1974). The percent distributions of eggs, relative to observed temperatures and depths, during MARMAP cruises in the MAB are mapped in Fahay (1998). Most eggs were collected at surface temperatures between 63 and 73 °F (19-23 °C) and over depths of 98 to 230 ft (30-70 m).

2.2.1.2 Larvae

Distribution (spatial & temporal)
The distribution of all larvae collected in the MAB and SAB is shown in Figure 4. Sampling effort in these two areas is also indicated in this figure and indicates a critical lack of sampling in the area immediately south of Cape Hatteras.

Spring-spawned cohort: Our understanding of the distribution of larvae in the South Atlantic Bight corresponding to the "spring-spawned" cohort is limited. The MARMAP ichthyoplankton program sampled there from 1973 through 1980, and, in general, bluefish larvae were collected in low densities, both in water column sampling with bongo nets or Isaacs-Kidd midwater trawls (Fahay 1998) and at the surface with two types of neuston net. Most of these larvae were found near the 656-ft (200 m) depth contour, placing them in close juxtaposition to the Gulf Stream and presumably enhancing their chances of advection to the north, as proposed by several authors (e.g. Kendall and Walford 1979, Powles 1981, Hare and Cowen 1993 and 1996). Their collection in April and May coincides with back-calculated birthdates determined from studies of estuarine recruits in the New York Bight (NYB; see "Juveniles").

Summer-spawned cohort: The distribution of larvae in the MAB is similar to that of the eggs. Larvae <0.44 in. (11 mm, the size at which they become pelagic-juveniles) first occur near Cape Hatteras and along the shelf edge in the Wilmington Canyon area during May, and continue to be present through the summer in increasing numbers throughout the southern and central parts of the MAB.

Although larvae are only rarely collected in estuarine waters, they have been reported from a few large systems in the MAB, including Narragansett Bay (Herman 1963) and several estuaries in New York/New Jersey/Delaware (Table 6).

Relative Abundance & Density
Spring-spawned cohort: The most dense concentrations of larvae collected by the MARMAP cruises (1973-1980) in the SAB were over the outer half of the continental shelf during April and May (Fahay 1998). Currents here flow toward the northeast and are affected by the Gulf Stream (Lee and Atkinson 1983), while on the inner shelf, wind-driven currents are important in affecting the drift of larvae (Powles 1981, Lee and Atkinson 1983). A secondary concentration of larvae was detected during late summer/early fall of one year (1976) and may indicate the existence of an

isolated spawning event (Fahay 1998). During 1979, all sampling was done by Isaacs-Kidd midwater trawl and was restricted to the shelf area near Charleston, South Carolina between February and August (Fahay 1998). Larvae were collected with this gear in low densities between February and mid-May, with two tows in April yielding somewhat higher densities.

Summer-spawned cohort: During June, peak larval abundances occur between Cape Hatteras and the Chesapeake Bay and off New Jersey. Larvae are most dense in the central part of the MAB in July and remain dense during August. Few larvae occur in the MAB during September. Larvae rarely occur deeper in the water column than 49 ft (15 m), and most are concentrated at a depth of about 13 ft (4 m) during the day, but are about equally distributed between that depth and the surface at night. Neuston sampling, therefore, is likely to drastically undersample bluefish when done during the day.

In MARMAP sampling 1977-1987, larvae occurred across the entire shelf but were most concentrated in mid-shelf depths. The percent distributions of larvae, relative to observed temperatures and depths, during MARMAP cruises in the MAB, are shown in Fahay (1998). Most larvae were collected at surface temperatures between 62 and 79 °F (17-26 °C) and over depths of 98 to 230 ft (30-70 m).

2.2.1.3 Pelagic-juveniles (larval to juvenile transition)

The bluefish transforms from a larva to a "pelagic-juvenile" stage, specially adapted for an oceanic, near-surface existence. This transformation occurs at sizes between 0.44 and 0.48 in. (11-12 mm; Hare and Cowen 1995). Swimming ability in many fish species dramatically improves during this transformation (e.g. Hunter 1981, Stobutzki and Bellwood 1994, Leis *et al.* 1996), and this improvement presumably applies to bluefish as well. It is during this stage that bluefish arrive at nursery areas in the central part of the MAB, after advection via the Gulf Stream from spawning areas in the SAB and after negotiating a crossing of the Slope Sea (Hare and Cowen 1996, Hare *et al.*, in prep.) and of the continental shelf (Cowen *et al.* 1993). This transport (active or passive) is crucial to the recruitment of these progeny to vital estuarine nursery areas, and therefore this life history stage might be considered as a critical bottleneck. There are no available data sets that adequately describe the distribution of this stage in the bluefish life history; however, limited observations have been made in the NYB (Figure 5; Shima 1989, Hare and Cowen 1996). These observations support the notion that temperatures below 55 to 59 °F (13-15 °C) impede the progress of this stage into MAB estuaries. In early June, these pelagic-juveniles mass at the shelf-slope temperature front and resume their inshore migration when that front dissipates (Hare and Cowen 1996).

2.2.1.4 Juveniles

Distribution (spatial & temporal)
It is unknown whether bluefish are "estuarine dependant," since the distribution of juveniles over the continental shelf is undescribed. However, it is known that many of the prey species of bluefish are estuarine dependent (e.g., menhaden). Marine fisheries scientists from several areas along the Atlantic coast, from Maine to Florida, indicated that almost all the estuarine and nearshore waters in their states serve as important habitat for juvenile and adult bluefish. Therefore, it can be concluded that many estuaries provide important bluefish habitats. The relative distribution of juveniles in estuaries along the east coast of the US as "common" or "abundant" (Table 6) is considered important.

In a survey of juvenile bluefish published in the early 1970s (Fahay 1998), then current occurrences were noted to differ from historical observations (Clark 1973). They were observed not to occur south of Daytona Beach through the 1970s, although juveniles were reported from estuaries as far south as Palm Beach, Florida in the early part of the century (Evermann and Bean 1898, Nichols 1913). It is suggested that the apparent high densities of juveniles in certain regions (e.g. New Jersey and South Carolina) were due to greater sampling effort. Remaining enigmatic occurrences include those in the freshwaters of the upper Chesapeake Bay (Mansueti 1955 and Lund 1961), although the Chesapeake and Delaware Canal may play a role in their presence there (Fahay 1998).

Relative Abundance & Density
Several young-of-the-year surveys (or surveys that adequately sample young stages) are conducted within Middle Atlantic Bight states. Annual collections of juvenile bluefish are shown for these in Figure 6. Several caveats pertaining to these results prevent these states' data from being compared directly. Some of these surveys are conducted throughout the year, while certain others are limited in their seasonal extent, and the resultant densities are therefore unequal. Although all results are expressed as "Number per Tow", tow lengths and gear characteristics can vary between states; thus, this number can be unequal between states. Finally, the definition of "juvenile" can vary between states, in some cases being based solely on length frequency distributions, in some cases only based on an arbitrary length. In most states, all fish <12 in. (30 cm) are considered juveniles, although in the Chesapeake Bay region, some of these could be Age 1+, if collected early in the year (Fahay 1998).

Despite these caveats, certain trends are evident in these data. There are signs of strong year classes in each state's data, but these do not necessarily match, temporally. In general, abundances are greater in states between Rhode Island and New Jersey, and considerably lower in states in the southern part of the Middle Atlantic Bight, further emphasizing the importance of the former.

The distribution of young-of-the-year summer-spawned (Figure 7) appears more concentrated than young-of-the-year from the spring-spawned cohort (Figure 8).

2.2.1.5 Adults

Distribution (spatial & temporal)
Length frequencies of trawl-collected bluefish were examined to determine age and size composition of catches (Figure 9). Modes of these frequencies were separable into spawning cohorts and year classes based on published studies and are the bases for the distribution maps (Fahay 1998).

Bluefish are migratory, and their distribution varies seasonally and according to size of individuals comprising schools. There is a trend for larger individuals to occur farther north during the summer (Wilk 1977). Anecdotal reports have suggested that larger adults winter on the outer part of the continental shelf of the MAB. One report witnessed a single fish landed from 55 fathoms off Marthas Vineyard during mid-January, 1950, and several hauls of 175 to 1,400 lbs per trip from the vicinity of Hudson Canyon during early February of the same year (Bigelow and Schroeder 1953). Another study simply reported "Boats engaged in the winter trawl fishery for fluke and scup along the outer margin of the Continental Shelf often bring in a few bluefish" (Hamer 1959). These reports have been perpetuated since (Lund 1961, Miller 1969, Lund and Maltezos 1970 and Hardy 1978), although recent winter trawl surveys do not indicate, nor are fisheries or other data available to support, their presence in the MAB during winter, except for a few occurrences near the shelf edge off Cape Hatteras.

Relative Abundance & Density
The percent distributions of age classes, relative to observed bottom temperatures and depths during spring and fall bottom trawl surveys in the MAB, are shown in Figures 10-11 and 12-13, respectively. All age classes, in both seasons, were mostly collected over depths <66 ft (20 m). They were collected over warmer temperatures during spring surveys, but showed little preference for temperatures during fall surveys, being found at most temperatures sampled.

Bluefish collected during the Southeast Area Monitoring and Assessment Program (SEAMAP) trawl survey in coastal waters of the SAB, 1990-1996, are shown in Fahay (1998; Figure 14). Length frequencies of these collections indicate most bluefish were young-of-the-year or Age 1 (Figure 15). Information on distributions over offshore portions of the SAB shelf are lacking for any size class.

2.2.1.6 Importance of bluefish in state waters

Whenever the MAFMC develops a major Amendment to an FMP, the individual states in the management unit (in this case Maine through Florida) are solicited for their knowledge of what areas might be identified as essential habitat. To this end, the following general knowledge is provided.

Marine fisheries scientists from several areas along the Atlantic coast, from Maine to Florida, indicated that almost all the estuarine and nearshore waters in their states serve as important habitat for juvenile and adult bluefish.

In New England, virtually every cove, embayment, and river mouth along the Connecticut shoreline is important as nursery and feeding habitat for bluefish (Gunn pers. comm.). Narragansett Bay and its tributaries, Mount Hope Bay and its tributaries, Little Narragansett Bay and the Pawacatuck River, coastal ponds, and the nearshore coastal zone all serve as nursery areas for juvenile bluefish in Rhode Island waters (Lynch pers. comm.). In addition, adult bluefish use these same waters as they migrate along the coast. Juvenile and adult bluefish seasonally occupy all the bays and estuaries, as well as nearshore and offshore waters in the state of Massachusetts (Kolek pers. comm.). In addition, juvenile bluefish occur in estuaries as far north as the southern and mid-coastal areas of Maine (Creaser and Perkins 1994). Juvenile bluefish have been collected as far north as Little Kennebec Bay and have been reported in Passamaquoddy Bay. Maine estuaries serve primarily as feeding and growing areas for bluefish larger than 4 pounds.

In New York, juvenile bluefish from one inch (25mm) and up use virtually every cove, embayment and creek mouth to the first impassible barrier on Long Island, New York harbor and the Hudson River to River Mile 70 on occasion and River Mile 40 routinely (Newell pers. comm.). Long Island Sound and all the nearshore waters serve as necessary for juvenile bluefish in New York (Young pers. comm.). In addition, adult bluefish use all tidal waters in New York State, up to River Mile 40 or so in the Hudson River, as they migrate along the coast. In fact, juvenile and adult bluefish seasonally occupy all tidal waters as described above (Newell pers. comm.).

Juvenile bluefish have been sampled in almost all the estuarine areas in the state of New Jersey including Raritan Bay, Manasquan River, Barnegat Bay and its tributaries, Little Egg Harbor Bay, Mullica River, Great Bay, Great Egg Harbor River and Bay, and the Hereford Inlet-Grassy Sound area (Halgren pers. comm.). It is probable that other inlet areas and embayments not sampled also serve as nursery areas for juvenile bluefish. In addition, New Jersey's bays and nearshore coastal waters are important feeding areas for migrating juvenile and adult bluefish. In Maryland, bluefish eggs have been reported as far inshore as southern Chesapeake Bay, with eggs and larvae most abundant in surface waters (Jones *et al.* 1988). Seasonally, juvenile and adult bluefish occur along

Maryland coastal beaches in nearshore waters and are widely distributed in Chesapeake Bay.

In North Carolina, although bluefish do not utilize nursery areas with relatively low salinities (less than 15 ppt), they are regularly collected in eastern Pamlico Sound and near Roanoke Island in the vicinity of inlets (Hogarth pers. comm.). Young bluefish (6 to 15 inches) are common during summer and fall in high salinity estuaries from Core Sound, North Carolina, and south. From spring through mid-winter, juvenile and adult bluefish are common in the nearshore ocean throughout the North Carolina coastal area, and larger fish are common from Cape Lookout northward. During winter, large bluefish are located in areas well beyond three miles from shore, especially from Cape Hatteras northward.

In Georgia, bluefish utilize most of the tidally influenced waters, rarely appearing in fresh and low salinity (0-10 ppt) areas (Shipman pers. comm.). During summer and early fall, high salinity salt marsh tidal creeks and rivulets in Georgia serve as important nursery areas for juveniles. Juvenile and adult bluefish utilize all areas containing abundant prey, including tidal creek, river, bay, and beach areas. Larger bluefish are seasonally abundant in temperate/subtropical reef areas located 11 to 50 miles offshore.

Estuaries and nearshore waters are important habitat for bluefish in Florida (Kimmel pers. comm.) and South Carolina (Joseph pers. comm.).

In addition to the state responses, data from the NOAA's Estuarine Living Marine Resources Program (ELMR; Tables 7 and 8) and amended ELMR data for early life stages (Table 6), while not as quantitative as the NEFSC trawl data (or various state collected seine and trawl data that will be incorporated in future iterations of this FMP), describes the bluefish spatial (Tables 6 and 7) and temporal (Table 8) relative abundance by life stage and month in the various coastal estuaries (Figures 16 and 17). Data from the Massachusetts Inshore Trawl Survey, Connecticut Trawl Survey - Long Island Sound, and the NMFS Trawl Survey - Hudson-Raritan Estuary/Sandy-Hook Bay has been appended to the bluefish document (Fahay 1998) and agree with Tables 6, 7, and 8.

2.2.2 Description and Identification of Essential Fish Habitat (Includes Habitat Areas of Particular Concern)

2.2.2.1 Methodology for description and identification

According to section 600.815 (a)(1), FMPs must describe EFH in text and with tables that provide information on the biological requirements for each life history stage of the species. These tables should summarize all available information on environmental and habitat variables that control or limit distribution, abundance, reproduction, growth, survival, and productivity of the managed species. The bluefish EFH background document (Fahay 1998) is considered the best scientific information available in order to meet National Standard 2 of the MSFCMA and will be relied upon heavily throughout this section.

As defined in section 3 (10) of the MSFCMA, essential fish habitat is "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." NMFS interprets "waters" to include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

A matrix of habitat parameters (i.e. temperature, salinity, light, etc.) for eggs, larvae, pelagic-juveniles, and juveniles and older, was developed in the bluefish EFH background document and included in this FMP as Table 5. Also included from the EFH background document are the amended (expanded by Fahay in the background document) ELMR data, and ELMR data by bluefish life stage in major Atlantic coast estuaries (Tables 6, 7 and 8 and Figures 16 for juveniles and 17 for adults). Researchers at Sandy Hook Laboratory are currently in the process of assembling numerous state survey data that can be used to identify EFH more quantitatively than the somewhat subjective means of how the ELMR data were derived. Currently, the Massachusetts Inshore Trawl Survey, Connecticut Trawl Survey of Long Island Sound, and NMFS Trawl Survey of the Hudson-Raritan Estuary and Sandy Hook Bay are the only state inshore survey data available in the consistent format being compiled by the personnel at Sandy Hook. Due to the strict time constraints of the October-Sustainable Fishery Act deadline, it is unlikely that all the state data will be incorporated in this amendment. However, as these and other data and information become available on bluefish, EFH bluefish designations can be reconsidered. In fact, every FMP must be reviewed at least every five years. It is important to understand that this EFH is a "work in progress," and that the process will evolve. The identification and description of EFH is a frameworked management provision (section 2.2.8 for process description).

Section 600.815 (a)(2)(i)(C) identifies the four levels of data and the approach that should be used. All the bluefish data are either Level 1 (presence/absence) or perhaps, at best, Level 2 (habitat related densities). No bluefish data are yet at Level 3 (growth, reproduction, and survival rates within habitats) or Level 4 (production rates by habitat types). The Council encourages NMFS and the scientific community to collect more habitat associated data and to strive towards assembling data that can be precisely used for the quantitative identification and description of EFH.

In section 600.815 (a)(2)(ii)(A), the Councils are directed to "interpret this information in a risk-averse fashion." In the next section, (B) it states "if a species is overfished, and habitat loss or degradation may be contributing to the species being identified as overfished, all habitats currently used by the species should be considered essential in addition to certain historic habitats that are necessary to support rebuilding the fishery and for which restoration is technologically and economically feasible."

The Council has interpreted the above direction of interpreting the information in a "risk-averse" fashion as the same as the NMFS policy on risk aversion as expressed by Schaefer (1995). Schaefer (1995) states that, although there is no formal agency (NMFS) definition of risk-averse decision making, it is discussed in several NMFS publications. A succinct agency statement regarding the rationale and objectives of this type of decision making was presented publicly in the *Strategic Plan of the National Marine Fisheries Service -- Goals and Objectives* dated 10 June 1991. This statement, according to Schaefer (1995), still represents the formal agency position on this issue. Under Goal 2 -- Maintain Currently Productive Fisheries, there is a discussion of risk-prone and risk-averse decision making. This clearly explains that the agency advocates risk-averse fishery management decisions because they reduce the risk of overfishing and give the benefit of the doubt to conservation, particularly in the face of uncertainty about the effects of management actions on the managed fishery resources. Also, in *Our Living Oceans,* December 1993, page 24, NMFS indicates that risk-averse decision making is a key element in the development of any improved management system, and that this policy means that managers should err on the side of caution with respect to long-term resource health when making fishery management decisions. Making such decisions based on short-term objectives often places the resource's long-term health at risk.

Currently, five data sets are available for determining bluefish EFH. These data sets are all Level 1 or, at best, Level 2 data. The data sets are: 1) MARMAP ichthyoplankton survey (Level 2); 2) NEFSC trawl survey (Level 2); 3) the amended ELMR data of distribution of early life history stages in estuaries between Maine and Florida (Fahay 1998; Level 1); 4) ELMR data (Level 1); and 5) SEAMAP data (Level 1). The limited state data appended to the bluefish background document (Fahay 1998) were also evaluated and, in general, agree with the ELMR data.

To identify and describe EFH offshore, the Mid-Atlantic Council is relying primarily on data and information derived from the NMFS ichthyoplankton and bottom trawl surveys. These surveys provide the best available information on the distribution and relative abundance of Council-managed species in offshore waters. Precise information on the distribution and relative abundance in inshore areas, especially in estuaries and embayments, has been sparse and incomplete in most cases.

To identify and describe EFH in state water, NOAA's Estuarine Living Marine Resources (ELMR) data will be used. The ELMR program has been conducted jointly by the Strategic Environmental Assessments (SEA) Division of NOAA's Office of Ocean Resources Conservation and Assessment (ORCA), NMFS, and other agencies and institutions. The goal of this program is to develop a comprehensive information base on the life history, relative abundance, and distribution of fishes and invertebrates in estuaries throughout the nation. The nationwide ELMR database was completed in 1994 and includes information for 135 species found in 122 estuaries and coastal embayments. The Jury *et al.* (1994) report summarizes information on the distribution and abundance of 58 fish and invertebrate species in 17 North Atlantic estuaries. The Stone *et al.* (1994) report summarizes information on the distribution and abundance of 61 fish and invertebrate species in 14 Mid-Atlantic estuaries. The Nelson *et al.* (1991) report covers 40 fish and invertebrate species in 20 estuaries between North Carolina and Florida. Until all the remaining state data are completely available in a uniform format, the ELMR data for adults and amended ELMR data for juveniles will be used to designate EFH in estuarine areas.

Reid *et al.* (1998) produced an appendix that is useful for all the species' habitat background documents produced by Sandy Hook Laboratory. Reid *et al.* (1998) describes the methods used in NEFSC, state, and other surveys. Data were collected in these surveys on distribution and abundance of all life stages and environmental variables. The Appendix document covers data sets 1, 2, and 5 as identified in the above paragraph, but does not describe the ELMR data.

The NEFSC ran the MARMAP (Marine Resources Monitoring, Assessment and Prediction) program that sampled fish eggs and larvae on monthly to bimonthly surveys covering the continental shelf form Cape Hatteras, NC to Cape Sable, Nova Scotia from 1977 through 1987 (Reid *et al.* 1998). A total of 81 surveys was made, and Reid *et al.* (1998) documents all the dates and numbers of tows for each survey where eggs and larvae were collected.

The NEFSC bottom trawl surveys have been conducted in the fall since 1963 and in the spring since 1968, with season surveys also being conducted in summer and winter on an intermittent basis. Distribution of juvenile and adult fish have been identified through trawl stations that were selected in a stratified random design that provides unbiased estimates of fish availability to the trawl gear in relation to the distribution of the species. Strata were defined based on water depth, latitude, and historical fishing patterns. Station allotments were approximately one station per 200 square nautical miles. At each station, the total catch was sorted by species, and the catch of each species was weighed and measured; very large catches were subsampled. Geographic range extends throughout the US Atlantic EEZ north of Cape Hatteras. Full details of this survey are described in Reid *et al.* (1998).

The South Atlantic Bight MARMAP and SEAMAP surveys are also described in Reid *et al.* (1998). In general, there is significantly less sampling than occurred with the NEFSC conducted surveys identified above. From 1973 through 1980, the South Carolina Marine Resources Research Institute conducted ichthyoplankton surveys throughout the South Atlantic Bight (SAB). The studies were sponsored by the NMFS MARMAP program office. A total of 1,163 samples were taken from Cape Hatteras, North Carolina through Cape Canaveral, Florida. Locations of all collections are identified in Reid *et al.* (1998).

The Southeast Area Monitoring and Assessment Program (SEAMAP) is a NMFS-sponsored survey conducted by the South Carolina Department of Natural Resources. Data were available from trawl surveys of coastal habitats between Cape Hatteras and Cape Canaveral from 1986 through 1996. Collections were made at randomly selected sites in predefined strata. During the 1986 through 1989 pilot phase of the survey, 19 strata were sampled. In 1989, five additional strata were added to the southern end of the study area, and each of the 24 strata was divided into an inshore and offshore stratum. Much less effort is expended and less data collected in this survey in comparison to the much longer time series NEFSC trawl surveys. Reid *et al.* (1998) details the SEAMAP program.

The objective of NOAA's ELMR program is the development of a consistent data base on the distribution, abundance, and life history characteristics of important fishes and invertebrates in the Nation's estuaries. The Nation-wide data base is divided into five study regions of which bluefish range over all three Atlantic study regions (North Atlantic, Mid-Atlantic, and Southeast). The data base contains the monthly relative abundance of each species' life stage by estuary for three salinity zones (seawater, mixing, and tidal fresh). Data collection was extensive, peer reviewed, evaluated relative to its reliability, but is also somewhat subjective. This subjectivity has generated some anxiety on the part of research scientists and is the main reason that, when the compilation of all the state data is completed in a consistent format, the quantitative state survey data will likely replace the ELMR data. However, at this time, ELMR data do meet National Standard 2 and are very important in describing essential bluefish habitat in the estuaries.

2.2.2.1.1 Five alternative approaches for describing EFH considered by the Mid-Atlantic Technical Team

One of the tasks of the Mid-Atlantic EFH Technical Team was to develop alternatives for consideration by the Council. The Mid-Atlantic EFH Technical Team met with several bluefish ecologists at the Sandy Hook Laboratory in February 1998 to discuss the types of recommendations for identification and description of EFH that could be technically defensible. Going into the meeting, it was envisioned that as many as five alternatives for EFH identification recommendations existed. These five were: 1) No action (NEPA requirement), 2) 100% of bluefish range because they are on the Secretary's list of overfished resources, 3) the bottleneck concept identified in the bluefish EFH background document -- where estuaries and nearshore areas are defined as bluefish EFH, 4) identification of EFH based on temperature or other key environmental variables, and 5) objective criteria using some percentage of the distribution i.e. 50%, 75%, 90% or 100% (Reid *et al.* 1998). The following is a discussion of the various alternatives and how they were approached with the Level 2 data (MARMAP ichthyoplankton and NEFSC trawl surveys).

1. **The "no action" alternative is included in the FMP because it is required by NEPA (National Environmental Policy Act) but it is not viewed by the Council as defensible. This alternative, or no EFH designation, could not meet the Congressional mandate identified in the 1996 reauthorized Magnuson-Stevens Act. With this alternative, there would be no stock improvement associated with the conservation of essential fish habitat.**

2. The second alternative (100% of distribution) would conform with the 1997 proposed EFH rule's criteria of listing all habitat where an overfished resource occurs as EFH. This alternative is supportable under the Interim Final Rule (1998) with only Level I data (i.e. presence/absence); however, there is Level 2 data available for bluefish. This alternative is also defensible if an association between the overfished status of the resource and the loss of essential habitat can be identified. Such an association is still under investigation.

3. At the meeting with the bluefish ecologists, there was significant discussion about trying to identify bottlenecks to bluefish recruitment (alternative 3). There is a statement on page 9 of the bluefish background document (Fahay 1998) that states that for the pelagic-juveniles, the transport into the "vital estuarine nursery areas, and therefore this life history stage might be considered as a critical bottleneck." Unfortunately, this approach by bluefish for identifying EFH with this type of alternative could not be supported at this time because of the reasons stated in the next sentence on page 9 of the bluefish EFH background document (i.e. "There are no available data sets that adequately describe . . .).

4. There also is the statement in the bluefish EFH background document (Fahay 1998) that temperatures below 55 to 59 °F (13-15 °C) impede progress into estuaries and the temperature figure on page 53 of Fahay (1998) where bluefish only become common in catches above 18 °C. This alternative 4 approach, of identifying EFH based on temperature regimes or some other critical environmental factor, is not currently supportable because of the lack of good quantitative environmental type association with the corresponding habitat data.

5. Finally, the use of some objective criteria, e.g. identifying some distributional percentage of the catches by area, seemed the only logically defensible position. For EFH designations based on Level 2 data, it is assumed that high value areas are those that support the highest density or relative abundance. This approach is supported by the technical guidance manual when Level 2 data (e.g., MARMAP ichthyoplankton data and the NEFSC trawl survey) are available (USDC 1998).

2.2.2.1.2 Viable alternatives from the five alternatives identified above

Alternatives 1, 3, and 4, above were eliminated by the Council from consideration. Alternative 1 simply because the no action alternative would not meet the Congressional mandate. Alternatives 3 and 4 may prove useful in the future, but were presently eliminated because of the lack of data at the current time (Fahay 1998). Public comment was solicited on any of the above considered five alternatives, or any other means of identifying EFH; however, the Council considered only alternatives 2 and 5 viable. In actuality, alternative 2 (100% of the distribution) is one of the options under alternative 5.

The Council seriously considered using Alternative 2 (100% of the distribution) because bluefish are currently considered overfished. When the initial EFH guidelines were proposed in 1997, EFH for overfished species was to be identified as wherever the resource occurred. The Council, commenting on those guidelines in 1997, suggested that the Secretary should establish rules on how much of the total habitat should really be declared EFH. The nation-wide relevant question is really how much habitat is necessary to maintain a healthy stock. The Council also considered using 100% because of the language in section 600.815 (a)(2)(ii)(B) where it states "if a species is overfished, and habitat loss or degradation may be contributing to the species being identified as overfished, all habitats currently used by the species should be considered essential in addition to certain historic habitats that are necessary to support rebuilding the fishery and for which restoration is technologically and economically feasible." There is some evidence to suggest that the current observed decline in bluefish may be due in part to factors in addition to over-exploitation (Moore 1996a). Both Crecco (1996a-b) and Terceiro (1996) have conducted preliminary investigations of such factors. As Terceiro (1996) notes:

> "The abundance of Atlantic coast bluefish has shown a steady decline since the early 1980's (NEFSC 1994 [NOAA 1994b]; this assessment, NEFSC In prep. [NOAA 1997b]). Bluefish recruitment has been below the long-term (1982-1995) average since 1990. The age structure of the stock has not been severely truncated, however, and the fishing mortality rate (F) has not risen to the extreme levels (>1.0) usually associated with dramatic stock declines. Fully recruited F for bluefish has ranged between 0.1 and 0.5 since 1982 (this assessment, ICA analysis). Therefore, the sequence of very high F leading to low spawning stock biomass (SSB) and subsequent low recruitment may not have occurred for Atlantic coast bluefish. Instead, other factors (environmental effects, interactions with competitors, interactions with prey) may have caused a period of poor recruitment success over the last decade, with a subsequent decline in SSB and a slow rise in F, as catches declined more slowly that stock size."

The Council did not really want to identify all areas where bluefish are found as EFH, thus they endorsed the concept of the Technical Team to use some objective criteria of less than 100% (Alternative 5) when supported by Level 2 data. The Technical Team, after meeting with the bluefish experts, suggested that, for overfished species, that 90% of the area where they occur be designated EFH, while when the resource is fully utilized or under utilized, that 75% be designated as EFH. Where only Level 1 (as in the South Atlantic) data are available, the Council has decided to identify 100% of the area in order to be risk averse. The Guidelines instruct that when using Level 1 data, "EFH can be inferred on the basis of distributions among habitats where the species has been found and on information on its habitat requirements and behavior."

The Technical Team, bluefish experts, Habitat Committee, Habitat Advisors, and Scientific and Statistical Committee all considered the five alternatives and concluded that the objective criteria (Alternative 5) was the most reasonable means for identifying and describing EFH. The Council deems this approach to be reasonable until delineation with Level 3 and Level 4 data can be available. As more information is amassed, the EFH areas delineated can be increased or reduced, as necessary, since the description and identification provision of EFH is one of the provisions of the FMP that is frameworked (section 2.2.8).

2.2.2.1.3 Options for calculation of EFH under the objective criteria -- alternative 5

Options under Alternative 5, the preferred alternative, are based on the relative densities and areas of higher concentrations of fish. Maps of EFH designation options are provided for each life history stage (Figures 18 through 21). The maps presented display the distribution and abundance data by ten minute squares. This is the most efficient and understandable spatial scale. The data can easily be compared to other data sets, information from the fishing industry, and existing management analyses. The New England Fishery Management Council is approaching the identification and description of EFH in a similar manner with the assistance of the NEFSC. Four options were considered for where Level 2 data are available (offshore areas north of Cape Hatteras) using the objective criteria (Figures 21 through 24):

1. The top two quartiles (50% of the observations);

2. The top three quartiles (75% of the observations);

3. 90% of the observations; or

4. 100% of the observations, or the entire observed range of the resource from the surveys.

The Level 2 data that are summarized in the ten minute square maps came from, 1) the NEFSC fall bottom trawl survey data from the mid 1960s through 1997 for bluefish and 2) the NEFSC MARMAP ichthyoplankton (eggs and larvae) data for 1977-1987 (larvae) and 1978-1987 (eggs); months varied by species - only months when eggs and larvae were captured were used in the maps.

Certain selection factors were applied to the bottom trawl and ichthyoplankton data bases to construct the data sets for the ten minute square maps. The selection factors were recommended by NEFSC scientists who collected and analyzed the data (Cross pers. comm.). Correction factors were used to standardize the bottom trawl catch due to variation in doors, trawls, and/or vessels among the surveys. Correction factors were applied to specific species (Reid *et al.* 1998).

Once the bottom trawl and ichthyoplankton data were selected, the summarization process was the same. Data were assigned to a ten minute square based on the location of the bottom trawl or ichthyoplankton sample. Only those squares that had more than four samples and one positive catch were selected (Cross pers. comm.). Catch data were transformed [ln(catch + 1)] and the mean of the transformed data was calculated for each ten minute square. Initially, the catch data were explored three different ways: 1) as straight ranked CPUE, 2) as ranked ln CPUE, and 3) as ranked CPUE by area (Figure 22 a through d by life stage).

The ten minute squares were ranked from high to low based on the mean catch. A total abundance index was calculated for the entire data set by summing the mean catch for all squares. The cumulative proportion of the total abundance index was calculated for the ranked ten minute squares beginning with the lowest rank (equals highest catch). Cutoff points at 50%, 75%, 90%, and 100% of the total abundance index were identified, and the squares at each of these cutoff points for each life stage were mapped (Figures 18 through 21). These groupings (50%, 75%, 90%, and 100%) represent areas of decreasing average density and increasing area.

Although this approach has some limitations, it is a scientifically objective approach that is based on the best available information. The NEFSC trawl survey does not survey everywhere that bluefish range offshore (especially in the deeper waters), and thus is constrained and significantly biased low. Bluefish and other pelagic species are not well sampled by bottom trawl type gear, and this is another reason the survey is biased low. The MARMAP survey is also biased low for eggs and larvae. State and inshore surveys are not necessarily compatible to NMFS data and to each other, nor are they all complete and in comparable format. None of the surveys collect the habitat information that is most needed (habitat type, substrate, biological associations, etc.). Additional sources of information (fishermen, historical, etc.) are sparse, difficult to verify, and largely anecdotal; however, public involvement in identifying and describing EFH was also solicited during the public hearing process and will be welcomed in future iterations of this work.

However, even while faced with these limitations, we can be reasonably assured of where most of the fish tend to be and where they tend to occur in higher concentrations. This is the first step toward a complete designation of EFH. Thus, for the current amendment process, the Council can designate EFH based on the limited information available and set the stage for gathering new and better information. This additional information will help us eliminate the limitations of the current process and either verify or discredit the assumptions used.

One important thing to remember is that this is not the last step in the process, but that the public, Habitat Advisors, Habitat Committee and the Council will have the opportunity to review and modify, if necessary, these EFH designations in the future through the framework process. During the public hearing process, the public will be asked to comment on these designations and be able to provide additional available information. Following public review, the Council had the opportunity to modify the EFH designations based on input gathered during this process. According to the Interim Final Rule, NMFS is required to provide their recommendation for the EFH designations, as well. NMFS provided their draft recommendation for bluefish EFH on 1 June 1998 to the Council (Rosenberg pers. comm.) and recommended that, for the offshore EFH north of Cape Hatteras (which is the only area with Level 2 data), the Council consider using the 75% of the area alternative rather than the Council preferred 90%. Most of the editorial/resolvable NMFS comments from the 1 June 1998 letter were incorporated into the public hearing revised version of the FMP. The major issue the Council and NMFS disagreed on was the percentage of the offshore area north of Cape Hatteras that was used for identifying EFH. However, no changes were made the Council at the October 1998 meeting when the FMP was approved for submittal.

The Council chose the preferred alternative to be the highest 90% of the area, ranked by CPUE, approach for the offshore Level 2 data (MARMAP and NEFSC) because it is the most inclusive and thus the most risk averse without going to 100% of the bluefish distribution. Remember that bluefish are currently overfished. Also remember that, while there is Level 2 data for offshore areas north of Cape Hatteras from the two NEFSC surveys, unquestionably, all of the problems identified above with these surveys bias the analyses low, and thus the offshore areas are likely a minimum designation for EFH. The Council made the decision on the description of EFH (the highest 90% of the area where bluefish were collected) with the above factors in mind at the March Council meeting and reconfirmed the preferred alternative, after reviewing NMFS draft recommendation, at the June Council meeting. The Council also decided to use the highest 90% of the area for all life stages (eggs, larvae, juveniles and adults) at this time for the designation of EFH since there was no readily apparent significant differences by life stage. There is not current information to support that life stage appears specifically limiting in terms of an ecological bottleneck-type habitat association, and therefore, to maintain consistency, the Council concluded there was no justification for different percentages by life stage. The Council is soliciting comments from the public on the appropriate percentages used for describing EFH where Level 2 data are available. Maps of the various life stages for bluefish with the associated percentages of offshore EFH designation are in Figures 18 for eggs, 19 for larvae, 20 for juveniles, and 21 for adults.

Although the Council did not accept the recommendation of NMFS (Rosenberg pers. comm.) to reduce the offshore EFH designation to 75% of the area where bluefish have been collected, they did adopt the NMFS recommendation that the survey data be augmented with available information about important areas for bluefish larvae and juveniles in the "slope sea" and Gulf Stream. Thus the preferred alternative includes the area of the "slope sea" and Gulf Stream between latitudes 29° 00 N and 40° 00 N, which was identified as a particularly important habitat for the pelagic juvenile stage in the bluefish EFH background document (Fahay 1998). Although the overall distribution of this life stage is not well described, the available data suggest that this area is important for the successful completion of the life history of the major annual bluefish cohort. Perhaps arguments could be made to extend the 40° 00 N to 42° 00 N and include all of northern New Jersey and Southern New England in this EFH designation, but for purposes of public hearings, the NMFS recommendation was accepted for this amendment.

The actual area (number of 10 minute squares) for each of the standardized percentage (50%, 75%, 90%, and 100%), as well as, corresponding variable percentages with catch for each of the four life stages, are presented in Tables 9a and 9b. For example, Table 9b shows that the highest 90% of the catch of adult bluefish were caught within 58% of the area (approximately 203 out of the 350 ten minute squares) where bluefish were caught in the survey, while the highest 90% of the area would encompass 315 out of the 350 ten minute squares where bluefish were caught. The logged catch analysis was not included in Tables 9a and 9b because its area is consistently between the area and catch analyses (Figure 22 a through d for the four life stages). The guidelines [Section 600.815 (a)(2)(C)(2)] state that "Density data should reflect habitat utilization, and the degree that a habitat is utilized is assumed to be indicative of that habitat value." The Technical Guidance manual (USDC 1997a) continues to explain that "EFH is the area of moderate to high abundance. However under certain conditions, habitats of low to moderate abundance may contribute to enough of the overall species productivity (e.g., reduced population size, when current population size of the species or stock is below historic levels)." Again, the Council selected one of the more inclusive approaches in its designation of offshore EFH because the surveys are inherently biased low for bluefish, and bluefish need to have their population rebuilt.

The "preferred" alternative for EFH designation using these data was chosen to be the highest 90% of the area where bluefish of each life stage were caught in the MARMAP ichthyoplankton and NEFSC trawl surveys. The CPUE and logged CPUE methods were not chosen because they tend to undervalue the area that is essential to bluefish. All lifestages of bluefish are pelagic and bluefish density in the trawl and ichthyoplankton survey are not fully reflective of their distribution (because of the patchy distribution of eggs and larvae and the inadequacy of a trawl to sample a pelagic species like bluefish). Also, for bluefish, the range seems to be extended in periods of higher abundance as indicated in the bluefish autumn trawl survey number per tow for both young-of-the-year (Figure 23) in the period 1980 through 1982 (high abundance), as compared to the period 1994 through 1996 (low abundance) and for adults (Figure 24). Bluefish are overfished; therefore, in an effort to be risk-averse, the Council prefers a more inclusive approach.

The only data presently available for south of Cape Hatteras (besides larvae in MARMAP) is the SEAMAP data which are only briefly summarized in Fahay (1998). As mentioned earlier, the state data are now being put into a consistent, usable electronic format by the NEFSC and should be available for the next iteration of EFH amendments. The SEAMAP survey samples young-of-year (YOY) bluefish (Figures 14 and 15) to Cape Canaveral, Florida. Although there are no survey data available from Cape Canaveral to Key West Florida, it is known that commercial and recreational fisheries exist throughout the Atlantic coast of Florida. The guidelines instruct that when using Level 1, "EFH can be inferred on the basis of distributions among habitats where the species has been found and on information about its habitat requirements and behavior." Therefore, in an effort to be risk averse and to follow the guidelines for Level 1 data, all waters with the same habitat parameters that are important to bluefish north of Cape Hatteras (i.e., pelagic waters with same depth, temperature, and salinity) from Cape Hatteras, North Carolina to Key West, Florida will be designated as EFH (Figure 25). Also, as recommended by NMFS (Rosenberg pers. comm.), the entire area below Cape Hatteras (roughly 35° 00 N) south to 29° 00 N (roughly Cape Canaveral) and inside the outer wall of the Gulf Stream is designated EFH, since this is particularly important habitat for the larvae and juvenile stages (Figure 5). The purpose of identifying a broad area south of Cape Hatteras as EFH is so that any project proponents should document the distribution and abundance in the areas that may be impacted with their activities. The Council solicited public comments on EFH designation in the South Atlantic because the offshore SEAMAP data are much less complete than offshore trawl data for the area north of Cape Hatteras.

The best available data to identify EFH in estuarine areas are the amended ELMR data for early life stages from the bluefish EFH background document (Table 6; Fahay 1998). The best available inshore data for adult bluefish are the ELMR data (Tables 7 and 8 and Figure 17). In order to continue its risk averse approach to EFH, the Council concluded that all estuaries where juvenile bluefish are listed as "common", "abundant", or "highly abundant" will be designated as EFH for juveniles (Table 10). The Council also decided that all estuaries where adult bluefish are listed as "common", "abundant", or "highly abundant" will be designated as EFH for adult bluefish (Table 10). Fahay (1998, p.10) states that it is presently unknown whether bluefish are "estuarine dependent" since the complete distribution of juveniles over the continental shelf is undescribed. However, marine fisheries scientists from several areas along the Atlantic coast, from Maine to Florida, indicated that almost all the estuarine and nearshore waters in their states serve as important habitat for juvenile and adult bluefish, warranting this approach for choosing EFH in estuarine waters (Laney 1997).

2.2.2.2 Specific description and identification of bluefish essential fish habitat

Eggs: 1) North of Cape Hatteras, pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ) at mid-shelf depths, from Montauk Point, NY south to Cape Hatteras in the highest 90% of the area where bluefish eggs were collected in the MARMAP surveys (Figure 26); and 2) South of Cape Hatteras, 100% of the pelagic waters over the Continental Shelf (from the coast out to the eastern wall of the Gulf Stream) through Key West, Florida at mid-shelf depths (Figure 25). Bluefish eggs are generally not collected in estuarine waters and thus there is no EFH designation inshore. Generally, bluefish eggs are collected between April through August in temperatures greater than 64 °F (18 °C) and normal shelf salinities (>31 ppt).

Larvae: 1) North of Cape Hatteras, pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ) most commonly above 49 ft (15 m), from Montauk Point, New York south to Cape Hatteras, in the highest 90% of the area where bluefish larvae were collected during the MARMAP surveys (Figure 27); 2) South of Cape Hatteras, 100% of the pelagic waters greater than 15 meters over the Continental Shelf (from the coast out to the eastern wall of the Gulf Stream) through Key West, Florida (Figure 25); and 3) the "slope sea" and Gulf Stream between latitudes 29° 00 N and 40° 00 N (Figure 5). Bluefish larvae are not generally collected inshore so there is not EFH designation inshore for larvae. Generally, bluefish larvae are collected April through September in temperatures greater than 64 °F (18 °C) in normal shelf salinities (>30 ppt).

Juveniles: 1) North of Cape Hatteras, pelagic waters found over the Continental Shelf (from the coast out to the limits of the EEZ) from Nantucket Island, Massachusetts south to Cape Hatteras, in the highest 90% of the area where juvenile bluefish are collected in the NEFSC trawl survey (Figure 28); 2) South of Cape Hatteras, 100% of the pelagic waters over the Continental Shelf (from the coast out to the eastern wall of the Gulf Stream) through Key West, Florida (Figure 25); 3) the "slope sea" and Gulf Stream between latitudes 29° 00 N and 40° 00 N (Figure 5); and 4) all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida in Table 10 (Figure 16). Generally juvenile bluefish occur in North Atlantic estuaries from June through October, Mid-Atlantic estuaries from May through October, and South Atlantic estuaries March through December, within the "mixing" and "seawater" zones (Nelson *et al.* 1991, Jury *et al.* 1994, Stone *et al.* 1994). Distribution of juveniles by temperature, salinity, and depth over the continental shelf is undescribed (Fahay 1998).

Adults: 1) North of Cape Hatteras, over the Continental Shelf (from the coast out to the limits of the EEZ), from Cape Cod Bay, Massachusetts south to Cape Hatteras, in the highest 90% of the area where adult bluefish were collected in the NEFSC trawl survey (Figure 29); 2) South of Cape Hatteras, 100% of the pelagic waters over the Continental Shelf (from the coast out to the eastern wall of the Gulf Stream) through Key West, Florida (Figure 25); and 3) all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida in Table 10 (Figure 17). Adult bluefish are found in North Atlantic estuaries from June through October, Mid-Atlantic estuaries from April through October, and in South Atlantic estuaries from May through January in the "mixing" and "seawater" zones (Nelson *et al.* 1991, Jury *et al.* 1994, Stone *et al.* 1994). Bluefish adults are highly migratory and distribution varies seasonally and according to the size of the individuals comprising the schools. Bluefish generally found in normal shelf salinities (> 25 ppt).

Finally, the MAFMC solicited input from the public on Figures 30 and 31, on where they perceive EFH for bluefish should be designated. No such comments were received.

2.2.2.2.1 Identification of Habitat Areas of Particular Concern

According to section 600.815 (a)(9), FMPs should identify habitat areas of particular concern (HAPC) within EFH where one or more of the following criteria must be met: (i) ecological function, (ii) sensitive to human-induced environmental degradation, (iii) development activities stressing, or (iv) rarity of habitat.

The MAFMC is not recommending any area as a Habitat Area of Particular Concern for bluefish at this time. The Council initially believed that the Gulf Stream and "slope sea", because of their importance for larvae and juveniles (Fahay 1998) could be identified as an HAPC, but the Council decided not to specify it because of the same reason this area could not be used solely as a means for identifying EFH (section 2.2.2.1.1-- alternative 3). Simply, as Fahay (1998) states: "There are no available data sets that adequately describe the distribution of this stage in bluefish life history..." The Council may designate HAPC as more data become available.

2.2.3 Fishing Activities that May Adversely Affect EFH

According to section 600.815 (a)(3), adverse effects from fishing may include physical, chemical, or biological alterations of the substrate, and loss of, or injury to, benthic organisms, prey species and their habitat, and other components of the ecosystem. FMPs must include management measures that minimize adverse effects on EFH from fishing, to the extent practicable, and identify conservation and enhancement measures. Councils must act to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable, if there is evidence that a fishing practice is having an identifiable adverse effect on EFH.

The following is a summary of general impacts of mobile fishing gear from the report "Indirect Effects of Fishing" (Auster and Langton 1998).

The discussion of the wide range of effects of fishing on EFH is based on the definition of EFH within the Act and the technical guidance produced by NMFS to implement the Act. The Act defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." For the purpose of interpreting the definition (and for defining the scope of this report), "waters" is interpreted by NMFS as "aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate" and "substrate" is defined to include sediment, hard bottom, structures, and associated biological communities. These definitions provide substantial flexibility in defining EFH based on our knowledge of the different species, but also allows EFH to be interpreted within a broader ecosystem perspective. Disturbance has been defined as "any discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment" (Pickett and White 1985). From an ecological perspective, fishing with fixed mobile gear is the most widespread form of direct disturbance in marine systems below depths which are affected by storms (Watling and Norse 1997). Disturbance can be caused by many natural processes such as currents, predation, iceberg scour (Hall, 1994). Human caused disturbance can result from activities such as harbor dredging and fishing with mobile gear. Disturbance can be gauged by both intensity (as a measure of the force of disturbance) and severity (as a measure of impact on the biotic community). Table 11 summarizes the relative effects of the range of agents which produce disturbances in marine communities.

One of the most difficult aspects of estimating the extent of impacts on EFH is the lack of high resolution data on the distribution of fishing effort. Fishers are often resistant to reporting effort based on locations of individual tows or sets (for the obvious reason of divulging productive locations to competitors and regulators). Effort data in many fisheries are apportioned to particular statistical areas for monitoring purposes. Using this type of data, it has been possible to obtain averages of effort, and subsequent extrapolations of area impacted, for larger regions.

Trawling effort in the Middle Atlantic Bight off the northeast U.S. was summarized by Churchill (1989). Trawled area estimates were extrapolated from fishing effort data in 30 minute latitude x 30 minute longitude grids. The range of effort was quite variable, but the percent area impacted in some blocks off southern New England was over 200% with one block reaching 413%. Estimating the spatial impact of fixed gears is even more problematic. For example, during 1996 there were 2,690,856 lobster traps fished in the state of Maine (Maine Department of Marine Resources, unpublished data). These traps were hauled on average every 4.5 d, or 81.4 times $year^{-1}$. Assuming a 1 m^2 footprint for each trap, the area impacted was 219 km^2. If each trap was dragged across an area three times the footprint during set and recovery, the area impacted was 657 km^2. A lack of data on the extent of the area actually fished makes analysis of the impacts of fishing on EFH in those fisheries difficult.

Auster and Langton (1998) summarize and interpret the current scientific literature on fishing impacts as they relate to fish habitat. These studies are discussed within three broad subject areas: effects on structural components of habitat, effects on benthic community structure, and effects on ecosystem level processes. The interpretation is based on commonalities and differences between studies. Fishing gear types are discussed as general categories (e.g., trawls, dredges, fixed gear). The necessity for these generalizations is based on two over-riding issues: (1) many studies do not specify the exact type and configuration of fishing gear used, and (2) each study reports on a limited range of habitat types. However, their interpretation of the wide range of studies is based on the type and direction of impacts, not absolute levels of impacts. Auster and Langton (1998) do not address the issues of bycatch (Alverson *et al.* 1994), mortality of gear escapees (Chopin and Arimoto 1995), or ghost fishing gear (Jennings and Kaiser 1998, p. 11-12 and references therein), as these issues do not directly relate to fish habitat and recent reviews have been published which address these subjects.

Impacts of fishing on fish habitat (Auster and Langton 1998) include the following:

1. **Effects on structural components of habitat;**

2. **Effects on community structure; and**

3. Effects of ecosystem processes.

2.2.3.1 Effects on structural components of habitat

Habitat has been defined as "the structural component of the environment that attracts organisms and serves as a center of biological activity" (Peters and Cross 1992). Habitat in this case is defined as the range of sediment types (i.e., mud through boulders), bed forms (e.g., sand waves and ripples, flat mud), as well as the co-occurring biological structures (e.g., shell, burrows, sponges, seagrass, macroalgae, coral). A review of 22 studies (Table 12) all show measurable impacts of mobile gear on the structural components of habitat (e.g., sand waves, emergent epifauna, sponges, coral), when defining habitat at this spatial scale. Results of each of the studies show similar classes of impacts despite the wide geographic range of the studies (i.e., tropical to boreal). In summary, mobile fishing gear reduced habitat complexity by: (1) directly removing epifauna or damaging epifauna leading to mortality, (2) smoothing sedimentary bedforms and reducing bottom roughness, and (3) removing taxa which produce structure (i.e., taxa which produce burrows and pits). Studies which have addressed both acute and chronic impacts have shown the same types of effects.

Some species with demersal life history stages, have obligate habitat requirements or recruitment bottlenecks (without the specific structural components of habitat populations of fishes with these habitat requirements would not persist). Few published accounts of the impacts of fixed gears on habitat have been written. Eno *et al.* (1996) studied the effects of crustacean traps in British and Irish waters. One experiment assessed the effects of setting and hauling pots on emergent epifaunal species (i.e., sea pens) on soft bottom. Both impacts from dragging pots across the bottom, and pots resting for extended periods on sea pens, showed the group was able to mostly recover from such disturbances. Limited qualitative observations of fish traps, longlines, and gill nets dragged across the seafloor during set and recovery showed results similar to mobile gear such that some types of epibenthos was dislodged, especially emergent species such as erect sponge and coral (High 1992, SAFMC 1991). While the area impacted per unit of effort is smaller for fixed gear than with mobile fishing gear, the types of damage to emergent benthos appear to be similar (but not necessarily equivalent per unit effort). Quantitative studies of fixed gear effects, based on acute and chronic impacts, have not been conducted.

The issue of defining pelagic habitats and elucidating effects of fishing is difficult because these habitats are poorly described at the scales that allow for measurements of change based on gear use. While pelagic habitat can be defined based on temperature, light intensity, turbidity, oxygen concentration, currents, frontal boundaries, and a host of other oceanographic parameters and patterns, there are few published data that attempt to measure change in any of these types of parameters or conditions concurrently with fishing activity and associations of fishes. Kroger and Guthrie (1972) showed that menhaden (*Brevoortia patronus* and *B. tyrannus*) were subjected to greater predation pressure, at least from visual predators, in clear versus turbid water, suggesting that turbid habitats were a greater refuge from predation. This same type of pattern was found for menhaden in both naturally turbid waters and in the turbid plumes generated by oyster shell dredging activities (Harper and Hopkins 1976). However, no work has been published that addresses the effects of variation in time and space of the plumes, or the effects using turbid water refugia on feeding and growth. There are also examples of small scale aggregations of fishes with biologic structures in the water column and at the surface. Aggregations of fishes may have two effects on predation patterns by: (1) reducing the probability of predation on individuals within the aggregation, and (2) providing a focal point for the activities of predators (a cue that fishermen use to set gear). For example, small fishes aggregate under mats of *Sargassum* (e.g., Moser *et al.* 1998) where high density vessel traffic may dis-aggregate mats. Also, fishes have been observed to co-occur with aggregations of gelatinous zooplankton and pelagic crustaceans (Auster *et al.* 1992, Brodeur in press). Gelatinous zooplankton are greatly impacted as they pass through the mesh of either mobile or stationary gear (unpublished observations), which may reduce the size and number of aggregations and disperse associated fishes. These changes could reduce the value of aggregating, resulting in increased mortality or reduced feeding efficiency.

Lack of information on the small scale distribution and timing of fishing make it difficult to ascribe the patterns of impacts observed in field studies to specific levels of fishing effort. Auster *et al.* (1996) estimated that between 1976 and 1991, Georges Bank was impacted by mobile gear (i.e., otter trawl, roller-rigged trawl, scallop dredge) on average between 200-400% of its area on an annual basis and the Gulf of Maine was impacted 100% annually. However, fishing effort was however not homogeneous. Sea sampling data from NMFS observer coverage demonstrated that the distribution of tows was nonrandom (Fig. 3). While these data represent less than 5% of overall fishing effort, they illustrated that the distribution of fishing gear impacts is quite variable.

Recovery of the habitat following trawling is difficult to predict as well. Timing, severity, and frequency of the impacts all interact to mediate processes which lead to recovery (Watling and Norse 1997). For example, sand waves may not be reformed until storm energy is sufficient to produce bedform transport of coarse sand grains (Valentine and Schmuck 1995), and storms may not be common until a particular time of year or may infrequently reach a particular depth, perhaps only on decadal time scales. Sponges are particularly sensitive to disturbance because they recruit aperiodically and are slow growing in deeper waters (Reiswig 1973, Witman and Sebens 1985, Witman *et al.* 1993). However, many species such as hydroids and ampelescid amphipods reproduce once or twice annually, and their stalks and tubes provide cover for the early benthic phases of many fish species and their prey (e.g., Auster *et al.* 1996, 1997b). Where fishing effort is constrained within particular fishing grounds, and where data on fishing effort is available, studies which compare similar sites along a gradient of effort have produced the types of information on effort-impact that will be required for effective habitat management (e.g., Collie *et al.* 1996, 1997; Thrush *et al.* in press).

The role these impacts on habitat have on harvested populations is unknown in most cases. However, a growing body of empirical observations and modeling demonstrate that effects can be seen in population responses at particular population levels. For example, Lindholm *et al.* (1998) have modeled the effects of habitat alteration on the survival of 0-year cohorts of Atlantic cod. The model results indicate that a reduction in habitat complexity has measurable effects on population dynamics when the adult stock is at low levels (i.e., when spawning and larval survivorship does not produce sufficient recruits to saturate available habitats). At high adult population levels, when larval abundance may be high and settling juveniles would greatly exceed habitat availability, predation effects would not be mediated by habitat, and no effect in the response of the adult population to habitat change was found.

Empirical studies that most directly link changes due to gear impacts changes on habitat structure to population responses are being carried out in Australia. Sainsbury (1987,1988, and 1991) and Sainsbury *et al.* (In press) have shown a very tight coupling between a loss of emergent epifauna and fish productivity along the north west continental shelf. In these studies, there was a documented decline in the bycatch of invertebrate epifauna, from 500 kg/hr to only a few kg/hr, and replacement of the most commercially desirable fish associated with the epifaunal communities by less valuable species associated with more open habitat. By restricting fishing, the decline in the fish population was reversed. This corresponded to an observed recovery in the epifaunal community, albeit the recovery for the larger epifaunal invertebrates showed a considerable lag time after trawling ceased. This work is based on a management framework which was developed to test hypotheses regarding the habitat dependence of harvested species. The hypotheses, described in Sainsbury (1988 and 1991), assessed whether population responses were the result of: (1) independent single-species (intraspecific) responses to fishing and natural variation, (2) interspecific interactions such that, as specific populations are reduced by fishing, non-harvested populations experienced a competitive release, (3) interspecific interactions such that, as non-harvested species increase from some external process, their population inhibits the population growth rate of the harvested species, and (4) habitat mediation of the carrying capacity for each species, such that gear induced habitat changes alter the carrying capacity of the area.

2.2.3.2 Effects on community structure

An immediate reduction in the density of non-target species is commonly reported following impact from mobile gear (Table 13). In assessing this effect, it is common to compare numbers and densities for each species before and after trawling and/or with an undisturbed reference site.

Time series data sets that allow for a direct long-term comparison of before and after fishing are essentially nonexistent, primarily because the extent to which the worlds oceans are currently fished was not foreseen, or because time series data collection focused on the fish themselves rather than the impact of fishing on the environment. Nevertheless, there are several benthic data sets that allow for an examination of observational or correlative comparisons before and after fishing (Table 14). Long-term effects of fishing included reduced densities of certain types of macrobenthos including sponges, coelenterates, bivalves, as well as seagrass meadows and increases in taxa such as polychaete. Other shifts occurred; for example, a decline in sea urchins to an increase in brittle stars, a decline in deposit feeders and an increase in suspension feeders and carnivores, as well as a decline in animal size.

Data sets on the order of months to a few years are more typical of the longer term studies on trawling impacts on benthic community structure. Otter trawl door marks were visible for 2 to 7 months with no sustained significant impact on the benthic community noted at high energy locations. In the lower energy muddy sand location, there was a loss in surficial sediments and lowered food quality of the sediments. The subsequent variable recovery of the benthic community over the following six months correlated with the sedimentary food quality which was measured as microbial populations, chlorophyll "a" and enzyme hydrolizable amino acids. While some taxa recolonized the impacted areas quickly, the abundances of some taxa (i.e., cumaceans, phoxocephalid and photid amphipods, nephtyid polychaetes) did not recover until food quality also recovered.

The most consistent pattern in fishing impact studies at shallow depths is the resilience of the benthic community to fishing. Most studies demonstrate that most taxa recover from the effects of trawling within months to years. These taxa include worms, bivalves, sea grass, and crustacea. In the case of the most intense trawling, seagrass beds did not recover after two years. Sometimes the community may shift to less commercially desirable species. In experimentally closed areas, there has been a recovery of fish and an increase in the small benthos but, based on settlement and growth of larger epifaunal animals, it may take 15 years for a system to recover. Two studies in the intertidal, harvesting worms and clams using suction and mechanical harvesting gear demonstrated a substantial immediate effect on the macrofaunal community, but from seven months to two years later, the study sites had recovered to pre-trawled conditions (Beukema 1995; Kaiser and Spencer 1996). In a South Carolina estuary, Van Dolah *et al.* (1991) found no long-term effects of trawling on the benthic community. The study site was assessed prior to and after the commercial shrimp season and demonstrated variation over time, but no trawling effects *per se*. Other studies of pre and post impacts from mobile gear on sandy to hard bottoms have generally shown similar results (Currie and Parry 1996, Gibbs *et al.* 1980, MacKenzie 1982), with either no or minimal long-term impact detectable.

Clearly, the long-term effects of fishing on benthic community structure are not easily characterized. The pattern that does appear to be emerging from the available literature is that communities that are subject to variable environments, and are dominated by short-lived species, are fairly resilient. Depending on the intensity and frequency of fishing, the impact of such activity may well fall within the range of natural perturbations. In communities which are dominated by long-lived species in more stable environments, the impact of fishing can be substantial and longer term. In cases such as described in Auster and Langton (1998) for Strangford Loch and the Australian shelf, recovery from trawling will be on the order of decades. In many areas, these patterns correlate with shallow and deep environments. However, water depth is not the single variable that can be used to characterize trawling impacts.

There are few studies that describe fishing impacts on soft muddy bottom communities or deep areas at the edge of the continental shelf. Such sites would be expected to be relatively low energy zones, similar to Strangford Loch, and might not recover rapidly from fishing disturbance. Studies in these relatively stable environments are required to pattern fishing impacts over the entire environmental range but, in anticipation of such results, it is suggested here that one should expect a tighter coupling between fish production and benthic community structure in the more stable marine environments.

2.2.3.3 Effects on ecosystem processes

A number of studies indicate that fishing has measurable effects on ecosystem processes. Disturbance by fishing gear in relatively shallow depths (i.e., 98 - 131 ft [30-40 m] depth) can reduce primary production by benthic microalgae. Recent studies in several shallow continental shelf habitats have shown that primary production by a distinct benthic microflora can be a significant portion of overall primary production (i.e., water column plus benthic primary production; Cahoon and Cooke 1992; Cahoon *et al.* 1990 and 1993). Benthic microalgal production supports a variety of consumers, including demersal zooplankton (animals that spend part of each day on or in the sediment and migrate regularly into the water; Cahoon and Tronzo 1992). Demersal zooplankton include harpacticoid copepods, amphipods, mysids, and other animals that are eaten by planktivorous fishes and soft bottom foragers (Thomas and Cahoon 1993).

The disturbances caused by fishing to benthic primary production and organic matter dynamics are difficult to predict. Semi-closed systems such as bays, estuaries, and fjords are subject to such effects at relatively small spatial scales. Open coastal and outer continental shelf systems can also experience perturbations in these processes. However, the relative rates of other processes may minimize the effects of such disturbances depending upon the level of fishing effort.

Mayer *et al.* (1991) discussed the implications of organic matter burial patterns in sediments versus soils. Their results are similar to organic matter patterns found in terrestrial soils. Sediments are essentially part of a burial system while soils are erosional. While gear disturbance can enhance remineralization rates by shifting from surficial fungal dominated communities to subsurface communities with dominant bacterial decomposition processes, burial caused by gear disturbance might also enhance preservation if material is sequestered in anaerobic systems. Given the importance of the carbon cycling in estuaries and on continental shelves to the global carbon budget, understanding the magnitude of effects caused by human disturbances on primary production and organic matter decomposition will require long-term studies as have been conducted on land.

2.2.3.3.1 Direct alteration of food web

In heavily fished areas of the world, it is undebatable that there are ecosystem level effects (Gislason, 1994; Fogarty and Murawski 1998) and that shifts in benthic community structure have occurred. The data to confirm that such shifts have taken place is limited at best (Riesen and Reise 1982), but the fact that it has been documented at all is highly significant. If the benthic communities change, what are the ecological processes that might bring about such change?

One of these is an enhanced food supply, resulting from trawl damaged animals and discarding both nonharvested species and the offal from fish gutted at sea. The availability of this food source might affect animal behavior, and this energy source could influence survival and reproductive success. There are numerous reports of predatory fishes and invertebrate scavengers foraging in trawl tracks after a trawl passes through the area (Medcof and Caddy 1971, Caddy 1973, Kaiser and Spencer 1994, Ramsey *et al.* 1997a, b). The prey available to scavengers is a function of the ability of animals to survive the capture process, either being discarded as unwanted by-catch or having been passed through or over by the gear (Meyer *et al.* 1981, Fonds 1994, Rumhor *et al.* 1994, Santbrink and Bergman 1994, Kaiser and Spencer 1995). Stomach contents data demonstrate that fish not only feed on discarded or damaged animals, and often eat more than their conspecifics at control sites, they also consume animals that were not damaged but simply displaced by the trawling activity, or even those invertebrates that have themselves responded as scavengers (Kaiser and Spencer 1994, Santbrink and Bergman 1994).

It is of interest to note that Kaiser and Spencer (1994) make the comment, as others have before them, that it is common practice for fishermen to re-fish recently fished areas to take advantage of the aggregations of animals attracted to the disturbed benthic community. The long-term effect of opportunistic feeding following fishing disturbances is an area of speculation.

Another process that can indirectly alter food webs is alteration of the predator community by removing keystone predators. In the northwest Atlantic, Witman and Sebens (1992) showed that onshore-offshore differences in cod and wolffish populations reduced predation pressure on cancrid crabs and other megafauna in deep coastal communities. They suggest that this regional difference in predation pressure is the result of intense harvesting of cod, a keystone predator, with cascading effects on populations of epibenthos (e.g., mussels, barnacles, urchins), which are prey of crabs. Other processes (e.g., annual variation in physical processes effecting survivorship of recruits, climate change, El Nino, recruitment variability of component species caused by predator induced mortality) can also result in food web changes; while it is important to understand the underlying causes of such shifts, precautionary approaches should be considered, given the strong inference of human caused effects in the many cases where studies were focused on identifying causes.

2.2.3.4 Summary

This review of the literature by Auster and Langton (1998) indicates that fishing, using a wide range of gear, produces measurable impacts. However, most studies were conducted at small spatial scales, and it is difficult to apply such information at a regional levels where predictive capabilities would allow us to manage at an ecosystem scale (Jennings and Kaiser 1998). Our current understanding of ecological processes related to the chronic disturbances caused by fishing make results difficult to predict (Auster and Langton 1998).

The removal of fish for human consumption from the world's oceans has effects not only on the target species, but also on the associated benthic community. The size specific, and species specific, removal of fish can change the system structure, but, fortunately, the regions of the continental shelf which are normally fished appear to be fairly resilient. The difficulty for managers is defining the level of resilience, in the practical sense of time/area closures or mesh regulations or overall effort limits, that will allow for the harvest of selected species without causing human induced alterations of the ecosystem structure to the point that recovery is unduly retarded or community and ecosystem support services are shifted to an alternate state (Steele 1996). Natural variability forms a backdrop against which managers must make such decisions, and, unfortunately, natural variability can be both substantial and unpredictable (Auster and Langton 1998).

2.2.3.5 Ghost fishing

Stationery gear may also cause adverse impacts to fish habitat by becoming ghost fishing gear. This occurs when storms, mobile gear, or boats rip traps, gill nets, and pots from their lines. This lost gear cannot be retrieved and may continue to fish for years (Rhodes 1995). In addition, ghost gill nets, traps, and pots change the structural component of the habitat. This can be a problem with commercial and recreational gear. This problem is currently impossible to quantify and the ecosystem effects are difficult to predict.

2.2.3.6 Fishing gear used within the bluefish range

Commercial fishing gear used in 1995 from Maine to Virginia is characterized in Table 15. These data were summarized from the 1995 Unpublished NMFS Weighout data. While total pounds of all species landed is not necessarily an indication of effort, it is some indication of overall fishing in both state and federal waters. Fishing gear which caught 1% or more of the landings for the Mid-Atlantic Council-managed species from Maine to Virginia in 1995 is presented in Table 16. Bottom gear used from Maine to Virginia includes bottom otter trawls, clam dredges, sea scallop dredges, and other dredges. Fishing gear that is managed by the South Atlantic Council is presented in Table 17.

2.2.3.7 Fishing impacts to bluefish EFH

Bluefish are a predominantly pelagic species (Fahay 1998). Life history data show that there are only loose associations of bluefish with any particular substrate or submerged aquatic vegetation (SAV; Fahay 1998). Bluefish do occur throughout the geographic range of SAV in the US. Juveniles are the only life stage which spatially and temporally co-occur on a regular basis with SAV. Bluefish juveniles and adults commonly occur in estuarine areas during the period of the year when eelgrass is present and prey on species which are associated with SAV. Some degree of linkage is likely, but given the extent to which the life cycle of bluefish occurs offshore outside the range of SAV, it is probably less than for other species (Laney 1997).

Bluefish prey include a wide range of species (Fahay 1998); therefore, it is unlikely that fishing gear will have a direct impact on the food web of bluefish. The possibility exists of an indirect effect on prey items through indirect ecosystems effects, but these are unquantifiable at this time.

While gear that impacts the bottom may have potential impact, it is unlikely that mobile fishing gear has a significant impact on bluefish EFH. However, effort of mobile gear in federal and state waters throughout the entire bluefish range is not quantified. Therefore, it is difficult to predict the exact impact that mobile gear in contact with the bottom will have on bluefish habitat. Of the three types of fishing impacts identified by Auster and Langton (1998), the only potential impact is indirect ecosystem effects. Although there is no way to gauge the intensity and severity of mobile gear in contact with the ocean bottom (bottom otter trawl, clam dredge, scallop dredge, and dredge-other), these gears are characterized currently as having a "potential adverse impact" on bluefish EFH (Table 18).

Although it is unlikely that stationary fishing gear will have a direct impact on bluefish EFH, ghost fishing by gill nets is a problem, but one which is impossible to quantify. Therefore, gill nets will be characterized as having potential impact on bluefish EFH. Consistent regulations along the entire Atlantic coast concerning trap numbers, placement, harvest, and use of biodegradable materials may help to alleviate this problem to some extent.

2.2.4 Options for Managing Adverse Effects from Fishing

According to section 600.815 (a)(4), fishery management options may include, but are not limited to: (i) fishing equipment restrictions, (ii) time/area closures, and (iii) harvest limits.

Since most of the state controlled waters (both estuaries and near-shore) are identified as EFH, the Council would like the states or ASMFC to inventory the fishing gears that are used in their waters. No management changes are anticipated in the immediate future but the Council and NMFS need to know if fishing gear impacts physical EFH, such as structured bottom or SAV beds. The states may choose to regulate various gear types if environmentally destructive fishing practices are occurring.

Research recommendations for areas where primary data are lacking, which would allow better monitoring and improved experimentation, ultimately leading to improved predictive capabilities, are described in Auster and Langton (1998) and listed in section 2.2.7. The data called for in Auster and Langton (1998) should allow managers in the future to regulate where, when, and how much fishing will be sustainable in regards to EFH. Conservation engineering should also play a large role in developing fishing gears which are both economical to operate and minimize impacts to environmental support functions.

2.2.5 Identification of Non-Fishing Activities and Associated Conservation and Enhancement Recommendations (Includes Cumulative Impacts)

NOTE: Sections 600.815(a)(5), 600.815(a)(6), and 600.815(a)(7) are all combined here, in order to better clarify the cause and effect association of actions.

According to section 600.815 (a)(5), FMPs must identify activities that have the potential to adversely affect EFH quantity or quality, or both. Broad categories of activities which can adversely affect EFH include, but are not limited to: dredging, fill, excavation, mining, impoundment, discharge, water diversions, thermal additions, actions that contribute to non-point source pollution and sedimentation, introduction of potentially hazardous materials, introduction of exotic species, and the conversion of aquatic habitat that may eliminate, diminish, or disrupt the functions of EFH.

Estuarine and coastal lands and waters are used for many purposes that often result in conflicts for space and resources (USDC 1985a). Some may result in the absolute loss or long-term degradation of the general aquatic environment or specific aquatic habitats, and pose theoretically significant, but as yet unquantified threats to biota and their associated habitats (USDC 1985a).

Multiple-use issues are constantly changing, as are the impacts of certain activities on living marine resources (USDC 1985a). Activities that occur on estuarine and coastal lands and waters and offshore waters may affect living marine resources directly and/or indirectly through habitat loss and/or modification. These effects, combined with cumulative effects from other activities in the ecosystem, may contribute to the decline of some species (USDC 1997a). The following discussion identifies and describes each multiple use issue and the potential threats associated with that issue. The adverse effects to marine organisms and their habitats resulting from any given threat are demonstrable, but usually not completely quantifiable. Environmental and socio-economic issues remain to be satisfactorily resolved with regard to impacts on marine organisms and their habitats.

The threats addressed in this section are germane to the entire Atlantic coast. All Mid-Atlantic Council managed species exist outside the geographic boundaries of Mid-Atlantic Council. Knowledgeable NMFS/Council individuals were asked to identify and prioritize non-fishing "perceived" threats. Once this list was complete, the resulting paper was distributed for review via mail, workshops, and conferences. The list is prioritized in regards to (1) perceived threats of habitat managers and others in the environmental community and (2) potential impact to bluefish habitat (Table 19). Information from the ASMFC workshop (Stephan and Beidler 1997) for habitat managers, which included a broad spectrum of constituents, was also used to identify threats.

Measures for conservation and enhancement of EFH

According to section 600.815 (a)(7), FMPs must describe options to avoid, minimize, or compensate for the adverse effects identified in the non-fishing threats section including cumulative impacts (section 2.2.5). The Councils are deeply concerned about the effects of marine and estuarine habitat degradation on fishery resources.

The MSFCMA provides for the conservation and management of living marine resources (which by definition includes habitat), principally within the EEZ, although there is concern for management throughout the range of the resource. Additionally, the MSFCMA provides [305(b)(3)(A)] that "Each Council may comment on, and make recommendations to the Secretary and any federal agency concerning, any activity authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by any federal or state agency that, in the view of the Council, may affect the habitat, including essential fish habitat, of a fishery resource under its authority." [305(b)(4)(B)] "Within 30 days after receiving a comment under subparagraph (A), a federal agency shall provide a detailed response in writing to the Council commenting under paragraph (3)."

The Councils have a responsibility under the MSFCMA to consider the impact of habitat degradation on bluefish. The following recommendations are made in light of that responsibility.

The goal of the Council is to preserve all available or potential natural habitat for bluefish by encouraging management of conflicting uses to assure access by bluefish and maintenance of high water quality to protect bluefish migration, spawning, nursery, overwintering, and feeding areas. Non-water dependent actions should not be authorized in bluefish EFH, if they adversely affect that habitat. Those non-water dependent actions in adjacent upland areas, such as agriculture, should be managed to minimize detrimental effects. Water dependent activities that may adversely affect bluefish EFH should be designed using environmentally sound engineering and best management practices to avoid or minimize those impacts. Regardless, the least environmentally damaging alternatives available should be employed to reduce impacts, both individually and cumulatively to bluefish EFH. Finally, compensatory mitigation should be provided for all unavoidable impacts to bluefish EFH.

Also, in general, the EPA and States should review their water quality standards relative to bluefish EFH areas and make changes as needed in estuarine and coastal areas. The EPA should establish water quality standards for the EEZ sufficient to maintain edible bluefish. Finally, water quality standards in bluefish EFH should be enforced rigidly by state or local water quality management agencies, whose actions should be carefully monitored by the EPA. Where state or local management efforts (standards/enforcement) are deemed inadequate, EPA should take steps to assure improvement; if these efforts continue to be inadequate, EPA should assume authority, as necessary.

Specific recommendations for the conservation and enhancement of bluefish EFH are found following discussion of individual habitat threats. The permitting/licensing authority should ensure that the project proponents adhere to the following recommendations.

2.2.5.1 Habitat threats prioritized for bluefish EFH

Many anthropogenic (caused by man) actions threaten the integrity of bluefish EFH. These threats have been prioritized based on the following:

1. All life stages are pelagic;

2. Inshore areas and estuaries are important habitat for bluefish larvae and juveniles [52 Atlantic estuaries are designated bluefish EFH (Table 7)];

3. Many inshore areas are designated as bluefish EFH (Figures 18-21), as are areas of the continental shelf;

4. The slope sea to estuaries may be a critical bottleneck for pelagic juveniles (Figure 5);

5. A loose association exists between bluefish and particular SAV types;

6. Many bluefish prey items are estuarine dependent (Table 4); and

7. Bluefish are known to concentrate polychlorinated biphenyls (PCBs).

Based on these considerations, threats that impact estuaries, inshore areas, and water quality are priority concerns in bluefish EFH (Table 19). The threats may be primary, direct (e.g., physically removing habitat by dredging or filling) or secondary, indirect (e.g., water quality degradation caused by urban or agricultural runoff). Many of the threats associated with bluefish EFH result in both primary and secondary impacts (e.g., coastal development, dredging and spoil disposal). Collectively, these impacts are "cumulative", which are often synergistic (i.e., the whole is greater than the sum of its parts). Some of the more challenging cumulative impacts are discussed in Section 2.2.5.14.

A more detailed discussion of the habitat threats affecting bluefish EFH and other Atlantic coast habitats follows. The described threats, and associated enhancement or mitigative recommendations, are related to both direct and indirect impacts. Again, their priority with respect to bluefish EFH is identified in Table 19.

2.2.5.2 Coastal development

Coastal development involves changes of land use; these activities include urban, suburban, commercial, and industrial construction along with the corresponding infrastructure. Coastal development also includes clearing of forestlands and filling of wetlands for agricultural use. Development first occurred in the coastal areas, and this historical trend continues. Approximately

80 % of the Nation's population lives in coastal areas (USEPA 1993). The U.S. Census Bureau estimates the 1997 world population to be 267.7 million in the United States and 5.84 billion in the world (Zero Population Growth Reporter pers. comm.). The US population rose 85 % within 50 miles of the coastlines between 1940 and 1980, compared to 70 % for the nation as a whole (Zero Population Growth Reporter 1994). The US Census Bureau projects that by the year 2000, the US population will reach 275 million, more than double its 1940 population.

Brouha (1994) points out our dilemma and states: "All our scientific work will be for naught if world human population growth and resource consumption are not stabilized soon. Unchecked growth, subsidies that support unsustainable resource use, and natural resource policies focused on short-term economic gains have created a conundrum for the long-term economic integrity and productivity of global ecosystems." However, Ehrlich (1990) may have stated the problem best: "No matter how distracted we may be by the number of problems now facing us, one issue remains fundamental: Overpopulation. The crowding of our cities, our nations, underlies all other problems."

During development, vegetated and open forested areas are converted to land uses that usually have increased areas of impervious surface resulting in increased runoff volumes and pollutant loadings (USEPA 1993). Eventually, changes to the physical, chemical, and biological characteristics of the watershed result. Vegetative cover is stripped from the land and cut-and-fill activities that enhance the development potential of the land occur. As population density increases, there is a corresponding increase in pollutant loadings generated from human activities (USEPA 1993).

Everyday household activities also generate numerous pollutants that affect water quality, including (USEPA 1993): improper disposal of used oil and antifreeze; frequent fertilization, pesticide application; improper disposal of yard trimmings; litter and debris; and pet droppings (USEPA 1993). Runoff from commercial land areas such as shopping centers, business districts, office parks, and large parking lots or garages may contain high hydrocarbon loadings and metal concentrations contributing more pollutants such as heavy metals, sediments, nutrients, and organics, including synthetic and petroleum hydrocarbons (USEPA 1993).

In addition to habitat impacts associated with the primary effects of coastal development, such as wetland filling, forest clearing, land grading, and construction, many secondary impacts resulting from changes in land use and population growth may occur. For example, urban/suburban development in low lying coastal areas and floodplains often causes a need for flood control that results in channel relocation, channelization, and impoundment of streams, rivers, and wetlands. Loss of natural wildlife habitats lead to wildlife management practices that promote wetland impoundment and filling shallows for bird breeding islands that deleteriously affect living marine resources. As population growth continues, the demand for nuisance insect control, such as ditching of tidal marshes and the spraying of insecticides for mosquito abatement, also continues.

Measures for conservation and enhancement

A). Filling of wetlands and shallow coastal water habitat should not be permitted in or near bluefish EFH. Mitigating or compensating measures should be employed where filling is totally unavoidable. Project proponents must demonstrate that project implementation will not negatively affect bluefish, their habitat, or their food sources.

B). Coastal development traditionally involved dredging and filling of shallows and wetlands, hardening of shorelines, clearing of riparian vegetation, and other activities that adversely affect the habitats of living marine resources. Mitigative measures are imperative for all development activities in and adjacent to bluefish EFH to prevent further degradation.

C). Adverse impacts resulting from construction should be avoided whenever practicable alternatives are identified. For those impacts that cannot be avoided, minimization through implementation of best management practices should be employed. For those impacts that can neither be avoided nor minimized, compensation through replacement of equivalent functions and values should be required.

D). Flood control projects in waterways draining into bluefish EFH should be designed to include mitigative measures and constructed using Best Management Practices (BMPs). For example, stream relocation and channelization should be avoided whenever practicable. However, should no practicable alternatives exist, relocated channels should be of comparable length and sinuosity as the natural channels they replace to maintain the quality of water entering receiving waters (i.e., bluefish EFH).

E). Wildlife management projects should not adversely affect Bluefish EFH. No impoundment of tidal wetlands or creation of islands should be authorized in bluefish EFH.

F). Mosquito control in bluefish EFH should be implemented using BMPs. Ditching should be in accordance with the principles of Open Marsh Water Management (e.g., restricting ditching to only those areas that are actively breeding mosquitoes; using specialized equipment, such as the rotary ditcher that slurries marsh peat thereby eliminating spoil disposal problems). Insecticides that are used should be selected to minimize impacts to non-target species (e.g., Abate: a short-lived insecticide that inhibits mosquito larvae from pupating).

2.2.5.2.1 Water withdrawal and diversion

As residential, commercial, and industrial growth continues, the demand for potable, process, and cooling water, flow pattern disruption, waste water treatment and disposal, and electric power increases. As ground water resources become depleted or contaminated, greater demands are placed on surface water through activities such as dam and reservoir construction or some other method of freshwater diversion. The consumptive use or redistribution of significant volumes of surface freshwater causes reduced river flow that can affect salinity regimes as saline waters intrude further upstream.

Turek *et al.* (1987) identified numerous studies that have correlated freshwater inflows and fishery resource production. Salinity is a primary ecological factor regulating the distribution and survival of marine organisms. The amount of freshwater entering an estuary influences physicochemical variables (e.g. salinity, temperature, and turbidity) directly affecting physiological processes in organisms. Salinity is also a primary factor regulating estuarine primary production. In addition, salinity governs fish distribution by secondarily restricting predator distribution (Turek *et al.* 1987).

Diversion of freshwater to other streams, reservoirs, industrial plants, power plants, and municipalities can change the salinity gradient downstream and displace spawning and nursery grounds. Patterns of estuarine circulation necessary for larval and planktonic transport can be modified. Such changes can expand the range of estuarine diseases and predators associated with higher salinities that affect commercial shellfish.

Measures for conservation and enhancement

A). Water withdrawals should be regulated to provide flows adequate to maintain the biological, chemical, and physical integrity of waters flowing into bluefish EFH. For example, under low flow conditions, flows should be maintained to prevent shifts in salinity regimes or changes in fish distribution.

B). The transfer of water from one basin to another is discouraged. Interbasin transfers can cause hydrological imbalances in rivers flowing into estuaries that can adversely affect bluefish EFH.

C). Dams constructed for reservoir development should not be sited in sensitive habitats. Dams that block anadromous rivers and streams (into which fish migrate from the sea) adversely affect bluefish directly by impairing prey production (e.g., river herrings) or indirectly (e.g., reducing flows that downstream salinity changes).

2.2.5.2.2 Construction

Construction activities within watersheds and in coastal marine areas often impact fish habitat. Some of these projects are of sufficient scope to singly cause significant, long-term or permanent impacts to aquatic biota and habitat; however, most are small scale, causing losses or disruptions to organisms and environment. The significance of small scale projects lies in the cumulative effects resulting from the large number of these activities (USDC 1985a).

Tremendous development pressures exist throughout the coastal area of the Northeast Region. More than 2,000 permit applications are processed annually by the NMFS Northeast Region for commercial, industrial, and private marine construction proposals. The proposals range from generally innocuous, open pile structures, to objectionable fills that encroach into aquatic habitats, thereby eliminating their productive contribution to the marine ecosystem (USDC 1985a). The projects range from small scale recreational endeavors to large scale commercial ventures to revitalize urban waterfronts (USDC 1985a).

Runoff from construction sites is by far the largest source of sediment in urban areas under development (USEPA 1993). Eroded sediment from construction sites creates many problems in coastal areas, including adverse impacts on water quality, sensitive habitats, SAV beds, recreational activities, and navigation (USEPA 1993). Other potential pollutants associated with construction activities include: pesticides (insecticides, fungicides, herbicides, and rodenticides); fertilizers used for vegetative stabilization; petrochemicals (oils, gasoline, and asphalt degreasers); construction chemicals such as concrete products, sealers, and paints; wash water associated with these products; paper; wood; garbage; and sanitary wastes (USEPA 1993). The variety of pollutants present and the severity of their effects are dependent on a number of factors (USEPA 1993):

1. The nature of the construction activity;

2. The physical characteristics of the construction site;

3. The proximity of surface waters to the nonpoint pollutant source.

Construction impacts can also include hydrological changes and water quality changes. Hydrologic and hydraulic changes occur in response to site clearing, grading, and the addition of impervious surfaces and maintained landscapes (USEPA 1993).

In addition, construction in and adjacent to waterways often involves dredging and/or fill activities which result in elevated suspended solids emanating from the project area. The distance the turbidity plume moves from the point of origin is dependent upon tides, currents, nature of the substrate, scope of work, and preventive measures employed by the contractor (USDC 1985a).

Measures for conservation and enhancement

The following measures were taken from Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (USEPA 1993).

A). Watershed protection/site development should be encouraged. Comprehensive planning for development on a watershed scale and for small-scale site development, including planning and designing to protect sensitive ecological areas, minimize land disturbances and retain natural drainage and vegetation whenever possible.

B). Pollution prevention activities, including techniques and activities to prevent nonpoint source pollutants from entering surface waters, should be implemented. Primary emphasis should be placed on public education to promote methods for proper disposal and/or recycling of hazardous chemicals, pet waste management strategies, management practices for lawns and gardens, onsite disposal systems (OSDSs), and commercial enterprises such as service stations and parking lots.

C). Construction erosion/sediment control measures should reduce erosion and transport of sediment from construction sites to surface water. A sediment and erosion control plan should be developed and approved prior to land disturbance for construction sites of less than 5 acres.

D). Runoff from new development should be managed so as to meet two conditions: (1) The average annual total suspended solid (TSS) loadings after construction is completed are reduced, a) by 80 %, or b) so that they are no greater than pre-development loadings; and (2) To the extent practicable, post-development peak runoff rate and average volume are maintained at levels that are similar to pre-development levels.

E). Construction site chemical control measures should address the transport of toxic chemicals to surface water by limiting the application, generation, and migration of chemical contaminants (i.e., petrochemicals, pesticides, nutrients) and providing proper storage and disposal.

F). Watershed management programs of existing developments should be developed that identify the sources, specify appropriate controls such as retrofitting or the establishment of buffer strips, and provide a schedule by which these controls are to be implemented.

G). New onsite disposal systems should be built to reduce nutrient/pathogen loadings to surface water. OSDS are to be designed, installed and operated properly, and to be situated away from open waterbodies and sensitive resources such as wetlands, and floodplains. Protective separation between the OSDS and the groundwater table should be established. The OSDS unit should be designed to reduce nitrogen loadings in areas where surface waters may be adversely affected.

H). Operating onsite disposal systems should prevent surface water discharge and reduce pollutant loadings to ground water. Inspection at regular intervals and repair or replacement of faulty systems should occur.

2.2.5.2.3 Construction of infrastructure

Construction activities of infrastructure, such as highways, bridges, and airports, can result in permanent loss or long-term disruption of habitat (USEPA 1993). For instance, highway construction often involves stream straightening or relocation. Dredging can degrade productive shallow water and destroy marsh habitat or resuspend pollutants, such as heavy metals, pesticides, herbicides and other toxins. Concomitant with dredging is spoil disposal, which traditionally occurred on marshes or in water where the effects were temporary (both short- and long-term) or permanent in terms of its degradation or destruction. Shoreline stabilization can cause gross impacts when intertidal and sub-tidal habitats are filled, or when benthic habitats are scoured by reflective wave energy. Stabilization can also cause subtle effects that result in gradual elimination of the ecosystem between the shore and the water (USEPA 1993).

Construction of bridges in coastal areas can cause significant erosion and sedimentation, resulting in the loss of wetlands and riparian areas (USEPA 1993). Additionally, since bridge pavements are extensions of the connecting highway, runoff waters from bridge decks also deliver loadings of heavy metals, hydrocarbons, toxic substances, and deicing chemicals to surface waters. Bridge maintenance can also contribute heavy loads of lead, rust particles, paint, abrasive, solvents, and cleaners into surface waters. Bridge structures should be located to avoid crossing over sensitive fisheries and shellfish-harvesting areas to prevent washing polluted runoff into the waters below. Also, bridge design should account for potential scour and erosion, which may affect shellfish beds and bottom sediments (USEPA 1993).

Wetland and riparian areas will need special consideration if affected by highway and bridge construction, particularly in areas where construction involves depositing fill, dredging, or installing pilings (USEPA 1993). Highway development is most disruptive in wetlands because it may cause increased sediment loss, alteration of surface drainage patterns, changes in the subsurface water table, and loss of wetland habitat (USEPA 1993).

Measures for conservation and enhancement

The following measures were taken from Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (USEPA 1993).

A). Roads, highways, bridges and airports should be situated away from areas that are sensitive ecosystems and susceptible to erosion and sediment loss. The siting of such structures should not adversely impact water quality, minimize land disturbances, and retain natural vegetation and drainage features.

B). Construction projects of roads, highways, bridges and airports should implement approved erosion and sediment control plans prior to construction, which would reduce erosion and improve retention of sediments onsite during and after construction.

C). Construction site chemical control measures for roads, highways, and bridges should limit toxic and nutrient loadings at construction sites by ensuring the proper use, storage, and disposal of toxic materials to prevent significant chemical and nutrient runoff to surface water.

D). Operation and maintenance should be developed for roads, highways, bridges, and airports to reduce pollutant loadings to receiving waters during operation and maintenance.

E). Runoff systems should be developed for roads, highways, bridges, and airports to reduce pollutant concentrations in runoff from existing roads, highways, and bridges. Runoff management systems should identify priority pollutant reduction opportunities and schedule implementation of retrofit projects to protect impacted areas and threatened surface waters.

F). The planning process for new and maintenance channel dredging projects should include an evaluation of the potential effects on the physical and chemical characteristics of surface waters and riparian habitat that may occur as a result of the proposed work and reduce undesirable impacts. The operation and maintenance programs for existing modified channels should identify and implement any available opportunities improve the physical and chemical characteristics of surface waters in those channels.

G). Bridges should be designed to include collection systems which convey surface water runoff to land-based sedimentation basins.

2.2.5.2.4 Shoreline stabilization

The erosion of shorelines and stream banks is a natural process that can have either beneficial or adverse impacts on the creation and maintenance of riparian habitat (USEPA 1993). Beaches are dynamic, ephemeral land forms that move back and forth onshore, offshore and along shore with changing wave conditions. Although bulkheads and seawalls protect the upland area against further land loss, they often create a local problem. Downward forces of water produced by waves striking a wall can produce a transfer of wave energy and rapidly move sand from the wall, causing scouring and undermining, and increased erosion downstream (USEPA 1993).

Groins are structures that are built perpendicular to the shore and extend into the water (USEPA 1993). Jetties are structures that are built perpendicular to shore to stabilize a channel. Groins and jetties trap sand in littoral drift and halt longshore movement. Sand traps created by these structures often result in inadequate supply of sand to replace that which is carried away. The "downdrift" beaches are often sand depleted, and severe erosion results (USEPA 1993).

Stabilization of eroding shorelines can be beneficial to living marine resources by reducing turbidity and subsequent sedimentation. However, some stabilization techniques can have secondary adverse impacts. Bulkheads harden shorelines, thereby eliminating the interaction between organisms and intertidal habitats during high tides. Wave energy reflecting off vertical bulkhead faces destabilize adjacent benthic habitats, rendering them less productive. Additionally, bulkheads are often constructed with chemically treated timber which contain toxic compounds that leach into adjacent waters through time.

Alternatives to vertical bulkheads are stone revetments (riprap) and vegetative stabilization. Unlike bulkheads, stone revetments are not vertical, and consequently, do not reflect wave energy. Also, the hard surfaces and interstitial spaces between the stones adds heterogeneity to local habitats. Vegetative stabilization provides the most natural means of erosion control, as well as enhancing local habitats. Marsh creation and stream bank "bioengineering" are two methods of vegetative stabilization that have proven effective in many circumstances.

Other types of shoreline stabilization, such as beach nourishment and groin fields, do not prevent erosion. Beach nourishment is the replacement of lost sediments with new sediments. Traditional beach nourishment is not structurally stabilized, but erosion abatement is accomplished through engineering design using appropriate grain-sized sand. Depending on the source of material for beach nourishment, ecological impacts are frequently greater at the borrow site than at the nourishment area.

Groins are vertical structures constructed of rock or wood that are placed at equidistant intervals along eroding shorelines, perpendicular to the shore. Groin fields generally do not incorporate additional sediments to the system, but depend on the trapping of suspended sediments carried by longshore currents. Groins characteristically accrete sediments on the updrift side and become sediment starved on the downdrift side. This problem can be prevented by constructing low-profile groins (i.e., the top of the structure being constructed at an elevation between mean high and mean low tide) that allow sediments to accumulate on both sides of the structure. Jetties are structures similar to groins, but are used to stabilize inlets, not curtail erosion. However, the accretion/starvation sediment patterns displayed by jetties are also demonstrated by groins.

Measures for conservation and enhancement

A). To stabilize eroding stream banks, vegetative methods such as marsh creation and vegetative bank stabilization ("bioengineering") are the preferred methods. Stream bank and shoreline features such as wetlands and riparian areas with the potential to reduce nonpoint source (NPS) pollution should be protected (USEPA 1993).

B). Vegetative shoreline stabilization should be implemented in bluefish EFH whenever feasible.

C). When wave energy is sufficient to preclude vegetative stabilization, stone revetments should be constructed in bluefish EFH. Revetments reduce reflected wave energy and provide habitat for benthic organisms.

D). Bulkheads, or shoreline hardening structures, should not be constructed in bluefish EFH when practicable alternatives exist.

E). Beach nourishment in bluefish EFH should only be considered when an acceptable source of borrow material is identified.

F). When groin fields are considered acceptable for construction in bluefish EFH, low-profile design should be employed.

G). When jetties intercept sediments in bluefish EFH, sand should be "by-passed". By-passing is the transfer of sediments from the accreted side of the jetties to the starved side thereby maintaining longshore sediment transport.

2.2.5.3 Nonpoint source (NPS) contamination

Nonpoint pollution generally results from land runoff, atmospheric deposition, drainage, groundwater seepage, or hydrologic modification (USEPA 1993). Technically, the term "nonpoint source" is defined to mean any source of water pollution that does not meet the legal definition of "point source" in section 502(14) (40 CFR 122.2) of the Clean Water Act. That definition states:

> The term "point source" means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture.

Nonpoint pollution is the pollution of our nation's waters caused by rainfall or snowmelt moving over and through the ground. Ground water is an important source of surface water and nutrients.

The U.S. Geologic Survey (USGS) has determined that 50% of the water in streams comes from ground water. The amount of ground water varies according to the type of rock and sediment beneath the land surface (USGS 1997). Up to one-half of the nitrogen entering the Chesapeake Bay travels through the ground water (USGS 1997). It is possible that about 10 to 20% of the phosphorous entering the Chesapeake Bay also travels through ground water (USGS 1997). Atmospheric deposition transports about 9% of the nitrogen and 5% of the phosphorous loads to the Chesapeake Bay (Alliance for Chesapeake Bay 1993).

As the runoff moves, it picks up and transports natural and anthropogenic pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and ground waters. Major pollutants in runoff include pathogens, nutrients, sediments, heavy metals, oxygen demanding substances, road salts, hydrocarbons, and toxics. Acid precipitation from nonpoint sources are demonstrable problems in Atlantic coastal and estuarine waters (USEPA 1993, USDC 1985a). In addition, hydrologic modification is a form of nonpoint source pollution that often adversely affects the biological, physical and chemical integrity of surface waters (USEPA 1993). The alteration of natural hydrology due to urbanization, and the accompanying runoff diversion, channelization, and destruction of natural drainage systems, have resulted in riparian and tidal wetland degradation or destruction. Temperature changes result from increased flows, removal of vegetative cover, and increases in impervious surfaces. NPS can be divided into three components, each of which will be discussed separately. Conservation measures will be offered for each component.

2.2.5.3.1 Urban NPS

Urban construction is not limited to the shore but also includes inland development that can adversely impact aquatic areas. One of the major problems arising from urban development is the increase in nonpoint source contamination of estuarine and coastal waters. Highways, parking lots, and the reduction of terrestrial and wetland vegetation facilitate runoff loaded with soil particles, fertilizers, biocides, heavy metals, grease and oil products, polychlorinated biphenyls, and other material deleterious to aquatic biota and their habitats. Atmospheric emissions resulting from certain industrial processes contain sulphurous and nitrogenous compounds that contribute to acid precipitation, a growing source of concern in some anadromous and fresh water sections of tidal streams. Nonpoint pollution is incorporated in water, sediments, and living marine resources (USDC 1985a).

Cumulatively, the effects of this environmental insult may have far reaching implications for fisheries resources. Estuarine and riverine plumes entering coastal waters are influenced by global and other dynamic forces. These plumes may remain as discrete water masses flowing close to the coast for hundreds of miles.

The purpose of vegetated filter strips is to remove sediment and other pollutants from runoff and wastewater by filtration, deposition, infiltration, absorption, adsorption, decomposition, and volatilization, thereby reducing the amount of pollution entering adjacent waterbodies. The ability of a wetland to act as a sink for phosphorus and the ability to convert nitrate to nitrogen gas through de-nitrification are two examples of the important nonpoint source pollution abatement functions performed by constructed wetlands.

Measures for conservation and enhancement

A). Watershed protection/site development should be encouraged. Comprehensive planning for development on a watershed scale and for small-scale site development, including planning and designing to protect sensitive ecological areas, minimize land disturbances and retain natural drainage and vegetation whenever possible.

B). Pollution prevention activities, including techniques and activities to prevent nonpoint source pollutants from entering surface waters should be implemented. Primary emphasis should be placed on public education to promote methods for proper disposal and/or recycling of hazardous chemicals, pet waste management strategies, management practices for lawns and gardens, onsite disposal systems (OSDSs), and commercial enterprises such as service stations and parking lots.

C). Watershed management programs of existing developments should be developed that identify the sources, specify appropriate controls, such as retrofitting or the establishment of buffer strips, and provide a schedule by which these controls are to be implemented.

D). Best Management Practices (BMPs) should be employed during urban construction to minimize impacts to bluefish EFH. Numerous specific conservation measures are provided at the end of Section 2.2.5.2.2 Construction.

E). The release of harmful chemical contaminants should be sequestered at their source thereby preventing their entering the atmosphere and subsequently being deposited in bluefish EFH.

F). BMPs should be implemented to manage stormwater to minimize the discharge of contaminants that degrade bluefish EFH or waters flowing into bluefish EFH. Stormwater should not be allowed to mix with sewage effluents (i.e., combined sewage/stormwater outfalls or CSOs). Where CSOs exist, the systems should be retrofitted to separate the two discharges.

2.2.5.3.2 Agricultural NPS

Agricultural development can affect fisheries habitat directly through physical alteration and indirectly through nutrient enrichment and chemical contamination. Fertilizers, herbicides, insecticides, and other chemicals are washed into the aquatic environment via uncontrolled nonpoint source runoff draining agricultural lands. These nutrients and chemicals can affect the growth of aquatic plants, which in turn affects fish, invertebrates, and the general ecological balance of the water body. Additionally, agricultural runoff transports animal wastes and sediments that can affect spawning areas, and degrade water quality and benthic substrate. One of the most serious consequences of erosional runoff is that the frequent dredging of navigational channels results in dredged material that requires disposal, often in areas important to living marine resources (USDC 1985a). Excessive uncontrolled or improper irrigation practices also contribute to nonpoint source pollution and often exacerbate the contaminant flushing, as well as deplete and contaminate ground water.

Agricultural development can significantly affect wetlands. Common flood control measures in low lying coastal areas include: dikes, ditches, and stream channelization. Wetland drainage is practiced to increase tillable land acreage. Wildlife management techniques that also destroy or modify wetland habitat include the construction of dredged ponds, low level impoundments, and muskrat ditches and dikes (USDC 1985a).

Animal waste (manure) includes fecal and urinary waste of livestock and poultry; process water (e.g., from a milking parlor); excess feed, bedding, litter, and soil (USEPA 1993). Pollutants associated with animal wastes include: oxygen-demanding substances; nitrogen, phosphorous, and other nutrients; organic solids; bacteria, viruses, and other microorganisms; salts; and sediments (USEPA 1993). Runoff transporting these wastes and pollutants may result in fish kills; dissolves oxygen depletion; unpleasant odors, taste and appearance; eutrophication; and shellfish contamination (USEPA 1993).

Another source of nonpoint source pollution from livestock is atmospheric deposition. Recent analyses by Dr. Joe Rudek clearly demonstrate that more than two-thirds (65-90%) of nitrogen excreted by the huge swine concentration in coastal North Carolina is evaporated as ammonia and redeposited within about 65 miles maximum – typically into nutrient sensitive waters, including the Neuse River and Tar-Pamlico Sounds (Rader pers. comm.).

Many agricultural fields are poorly drained. To facilitate crop planting and cultivation, elaborate systems of drainage ditches are excavated. These drainage systems are frequently excavated through wetlands and ultimately discharged into natural waterways. Drainage systems serve as conduits transporting fertilizers, pesticides, sediment, and other contaminants that degrade habitat and water quality.

Measures for conservation and enhancement

A). EPA and appropriate agencies should establish and approve criteria for vegetated buffer strips in agricultural areas adjacent to bluefish EFH to minimize pesticide, fertilizer, and sediment loads to these areas critical for bluefish survival. The effective width of these vegetated buffer strips should vary with slope of terrain and soil permeability.

B). The Natural Resources Conservation Service and other concerned federal and state agencies should conduct programs and demonstration projects to educate farmers on improved agricultural practices that would minimize the wastage of pesticides, fertilizers, and top soil and reduce the adverse effects of these materials on bluefish EFH areas (MAFMC 1990a).

The following measures were taken mainly from Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (USEPA 1993).

C). Delivery of sediment from agricultural lands to receiving waters should be minimized. Land owners have a choice of one of two approaches: (1) apply the erosion component of the U.S. Department of Agricultures Conservation Management System through such practices as conservation tillage, strip cropping, contour farming, and terracing, or (2) design and install a combination of practices to remove settleable solids and associated pollutants in runoff for all but the larger storms.

D). New confined animal facilities and existing confined animal facilities over a certain size should be designed to limit discharges to waters of the U.S. by storing wastewater and runoff caused by all storms up to and including the 25-year frequency storms. For smaller existing facilities, the management systems that collect solids, reduce contaminant concentrations, and reduce runoff should be designed and implemented to minimize the discharge of contaminants in both facility wastewater and runoff caused by all storms up to and including 25-year frequency storms.

E). Stored runoff and solids should be managed through proper waste utilization and use of disposal methods which minimize impacts to surface/ground water. Confined animal facilities required to obtain a discharge permit under the National Pollutant Discharge Elimination System (NPDES) permit program should not be subject to these recommendations.

F). Development and implementation of comprehensive nutrient management plans should occur. The fundamentals of a comprehensive nutrient management plan include a nutrient budget for the crop, identification of the types and amounts of nutrients necessary to produce a crop based on realistic crop yield expectations, and an identification of the environmental hazards of the site. Other items include soil tests and other tests to determine crop nutrient needs and proper calibration of nutrient equipment.

G). Pesticide and herbicide management should minimize water quality problems by reducing pesticide use, improving the timing and efficiency of application (not within 24 hours of expected rain or irrigation), preventing backflow of pesticides into water supplies, and improving calibration of pesticide spray equipment. Strategies such as integrated pest management (IPM) should be used. IPM strategies include evaluating current pest problems in relation to the cropping history, previous pest control measures, and applying pesticides only when an economic benefit to the producer will be achieved, i.e., application based on economic thresholds. If pesticide applications are necessary, pesticides should be selected based on consideration of their environmental impacts such as persistence, toxicity, and leaching potential.

H). Livestock grazing should protect sensitive areas, including streambanks, wetlands, estuaries, ponds, lake shores, and riparian zones. Protection is to be achieved with improved grazing management that reduces the physical distance and direct loading of animal waste and sediment caused by livestock by restricting livestock access to sensitive areas through a range of options.

I). Upland erosion is to be reduced by either: (1) applying the range and pasture components of a Conservation Management System, or (2) maintaining the land in accordance with the activity plans established by either the Bureau of Land Management or the Forest Service. Such techniques include the restriction of livestock from sensitive areas through locating salt, shade, and alternative drinking sources away from sensitive areas, and providing livestock stream crossings.

J). Irrigation systems that deliver necessary quantities of water, yet reduce nonpoint pollution to surface waters and groundwater, should be developed and implemented. To achieve this, uniform application of water based upon an accurate measurement of cropwater needs and the volume of irrigation water applied should be calculated. When applying chemicals through irrigation (a process known as chemigation), special additional precautions apply. In state waters, conflicting laws may take precedence. In no case should irrigation be practiced to the point that runoff occurs from the field.

K). Best Management Practices should be implemented to minimize habitat impacts when agricultural ditches are excavated through wetlands that drain to bluefish EFH.

L). NPDES/ State Pollutant Discharge Elimination System (SPDES) permits in consultation with state fishery agency should be required for agricultural ditch systems that discharge into bluefish EFH.

M). Acceptable swine waste treatment technologies should be developed to replace current practices which rely upon evaporation or movement through groundwater to dispose of nitrogen (Rader pers. comm.).

N). Nitrogen reduction programs should account for airborne delivery (Rader pers. comm.).

2.2.5.3.3 Silvicultural NPS

Federal land management has allowed activities to occur which have degraded riparian and riverine habitat in the national forests, thereby contributing to the decline of marine and anadromous fishes (USDC 1997a). The impacts of forest activities conducted within the framework of these land use plans include effects on marine and anadromous species and significant habitat degradation from timber harvest, road construction, grazing, mining, outdoor recreation, small hydropower development, and water conveyance permitting. These actions have: reduced physical, biological and channel connectivity between streams and riparian areas, floodplains, and uplands; increased sediment yields (leading to pool filling and elimination of spawning and rearing habitat); reduced or eliminated large woody debris; reduced or eliminated the vegetative canopy (leading to increased temperature fluctuations); altered peak flow timing; increased water temperature; decreased dissolved oxygen; caused streams to become straighter, wider, and shallower; and have degraded water quality by adding toxic chemicals through mining and pest control. These effects, combined with cumulative effects from activities on nonfederal lands, have contributed to the decline of marine and anadromous fish species (USDC 1997a).

Silvicultural contributions to water pollution has been recognized by all states with significant forestry activities (USEPA 1993). On a national level, silviculture contributes approximately 3 to 9% of nonpoint source pollution to the nation's waters (USEPA 1993). Local impacts of timber harvesting and road construction on water quality can be severe, especially in smaller headwater streams. Studies on forest land erosion have concluded that surface erosion rates on roads often equaled or exceeded rates reported for severely eroding agricultural lands (USEPA 1993). These effects are of greatest concern where silvicultural activity occurs in high-quality watershed areas that provide municipal water supplies or support cold-water fisheries. The USEPA (1993) reported that 24 states have identified silviculture as a problem source contributing to nonpoint source pollution. Some states report up to 19% of their river miles impacted by silviculture. On federal lands, such as national forests, many water quality problems can be attributed to the effects of timber harvesting and related activities (USEPA 1993).

Measures for conservation and enhancement

The following measures were taken from Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (USEPA 1993).

A). Preharvest planning should ensure that silvicultural activities take into account potential nonpoint source pollutant delivery to surface waters. Key aspects of forestry operations relevant to water quality protection that should be addressed, include: the timing, location, and design of harvesting and road construction; the identification of sensitive areas or high-erosion-hazard areas; and the potential for additional cumulative contributions to existing water quality impairments.

B). Streamside management areas (SMA) should be established along bluefish EFH and should be managed to protect the water quality of the adjacent waterbody.

C). Delivery of sediment from road construction or reconstruction should be reduced. This is to be accomplished by following the preharvest plan layouts.

D). Existing roads should be managed to prevent sedimentation and pollution from runoff-transported materials. Measures taken can include the use of inspections and maintenance actions to prevent erosion of road surfaces and ensure the continued effectiveness of stream crossing structures. Appropriate actions for closing roads that are no longer in use should also be taken.

E). NPS pollution resulting from timber harvesting operations should be reduced by taking into account the location of landings, the operation of ground-skidding and cable yarding equipment, and preventing of pollution from petroleum products. Harvesting practices that protect water quality and soil productivity can also reduce total mileage of roads and skid trails, lower equipment maintenance costs, and provide better road protection and reduce road maintenance. Appropriate skid trail location and drainage, and proper harvesting in SMAs should be addressed.

F). Impacts of mechanical site preparation and regeneration operations should be reduced, and on-site potential nonpoint source pollution should be confined. Measures such as keeping slash materials out of drainages, operating machinery on the contour, and protecting the ground cover in ephemeral drainages and SMAs should be implemented.

G). Potential nonpoint source pollution and erosion resulting from prescribed fire for site preparation and from methods for suppression of wildfire should be reduced. Prescribed fires should be conducted under conditions to avoid the loss of litter and incorporated soil organic matter. Bladed firelines should be stabilized to prevent erosion, or practices such as handlines, firebreaks, or hose lays should be used where possible.

H). Erosion and sedimentation by the rapid revegetation of areas of soil disturbance from harvesting and road construction should be reduced. The disturbed areas to be revegetated are those localized areas within harvest units or road systems where mineral soil is exposed or agitated such as road cuts, fill slopes, landing surfaces, cable corridors, or skid trails.

I). Pesticide and herbicides should be managed to minimize water quality problems by reducing pesticide use, improving the timing and efficiency of application (not within 24 hours of expected rain or irrigation), preventing backflow into water supplies, and improving calibration of spray equipment.

2.2.5.4 Dredging and disposal of dredged material

Dredging and disposal of dredged material can create significant impacts in aquatic ecosystems. The purpose of dredging in nearshore and offshore areas include: creation and maintenance for shipping and recreational boating, construction of infrastructure, and marine mining. During dredging operations, bottom sediments are removed, disturbed, and resuspended (Chytalo 1996). Historically, dredged material was disposed of by being discharged in designated open-water disposal areas near the dredging site. Because of concern about environmental damage, disposal of dredged material has begun to be tightly regulated (Chytalo 1996). Environmental impacts of dredging include:

1. Direct removal/burial of organisms as a result of dredging and placement of dredged material;

2. Turbidity/siltation effects, including increased light attenuation from turbidity, alteration of bottom type, and physical effects of suspended sediments on organisms;

3. Contaminant release, and uptake, including nutrients, metals, and organics from interstitial water and the resuspended sediments;

4. Release of oxygen-consuming substances, such as sulfides;

5. Noise/disturbance to terrestrial organisms;

6. Alterations to the hydrodynamic regime and physical habitat; and

7. Loss of wetland, SAV beds, and riparian habitat.

Excluding the potential of new work being authorized in sensitive habitats, the major problem associated with dredging is disposal of dredged material (spoil). Almost 60% of the spoil generated nationally (approximately 310 thousand metric wet tons) is discharged into estuarine and marine habitats (OTA 1987). This volume can be anticipated to increase as the trend for deeper channels and port expansions escalate.

Although alternatives to in-water disposal have been proposed, such as transporting spoil to inland areas to reclaim strip mines and use as a raw material for manufacturing bricks, only upland disposal in adjacent coastal areas has proven to be practicable. However, as the demand for coastal development increases, the amount of available uplands is diminishing, while the cost of those lands is increasing. Additionally, mounting evidence indicates that long-term use of upland spoil sites cause adverse impacts, such as salinity intrusion in shallow aquifers.

Diked containment islands in estuaries have been effective, cost efficient methods to dispose of dredged material. However, these islands, such as Craney Island in Virginia and Hart-Miller Island in Maryland, require hundreds of acres each for construction. This is an irreversible commitment of estuarine habitat. Consequently, sensitive areas must be identified and avoided. Construction of spoil islands must be restricted to those areas that will have the least impact on estuarine and marine ecosystems. Compensatory mitigation to increase the carrying capacity within the affected estuaries to offset these impacts must also be a requirement of island construction.

More recently, there has been a trend toward the "beneficial use" of dredged material. Some uses of dredged material can be truly beneficial, while some are merely a trade-off of one habitat type for another, usually at the expense of living marine resources. Some examples of true beneficial uses are by-passing sediments removed from natural littoral processes to down-drift, starved beaches, restoration of structure to depleted oyster reefs, and restoration of eroded wetlands to abate erosion. However, other proposed beneficial uses, such as creating bird breeding islands in shallow water habitats, only deplete valuable fish habitats (Goodger pers. comm.).

Measures for conservation and enhancement

A). Filling of wetlands or coastal shallow water habitat should not be permitted in or near EFH areas. Mitigating or compensating measures should be employed where filling is totally unavoidable. Project proponents must demonstrate that project implementation will not negatively affect bluefish, their EFH, or their food sources.

B). No dredging or dredge spoil placement should take place in SAV beds.

C). Best engineering and management practices (e.g., seasonal restrictions, dredging methods, disposal options, etc.) should be employed for all dredging and in-water construction projects. Such projects should be permitted only for water dependent purposes when no feasible alternatives are available. Mitigating or compensating measures should be employed where significant adverse impacts are unavoidable. Project proponents should demonstrate that project implementation will not negatively affect bluefish, their EFH, or their food sources.

D). Construction of spoil containment islands should be avoided in bluefish EFH, except when no practicable alternatives are available. In those exceptional cases when island construction is necessary, sites should be selected that result in the least damaging impacts to bluefish EFH.

E). "Beneficial Use" proposals in bluefish EFH should be compatible with existing uses by bluefish. Conflicting uses, such as construction of bird breeding islands, should not be authorized.

The following measures were taken from Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (USEPA 1993).

F). When projects are considered and in review for open water disposal permits for dredged material, state and federal permitting agencies should identify the direct and indirect impacts such projects may have on EFH.

G). No unconfined disposal of contaminated dredge material, sewage sludge, or industrial waste should ever be allowed in EFH.

H). Disposal sites should be located in uplands when possible.

I). The creation of new habitat at the expense of another naturally functioning system (e.g. marsh creation with dredge material placed in shallow water habitat) should be fully justified and documented, given best available information, through a demonstrated net gain in EFH.

2.2.5.5 Port development, utilization, and shipping

Major ports along the Atlantic coast include those at Miami Florida, Jacksonville Florida, Savannah Georgia, Charleston South Carolina, Wilmington North Carolina, Norfolk Virginia, Baltimore Maryland, Wilmington Delaware, Philadelphia Pennsylvania, New York New York, Providence Rhode Island, Boston Massachusetts, Portsmouth New Hampshire, and Portland Maine. These ports handle primarily grains, coal, ores, and manufactured commodities. Some of these ports and many other ports along the Atlantic seaboard (e.g. Gloucester and New Bedford Massachusetts, Rockland Maine, Newport and Point Judith Rhode Island, Hampton-Norfolk Virginia, Ocean City Maryland) also support major commercial and recreational fisheries (USDC 1985a).

All ports require shoreline infrastructure, mooring facilities, and adequate channel depth. Ports compete fiercely for limited national and international markets and continually strive to upgrade their facilities. Dredging and dredged material disposal, filling of aquatic habitats to create fast land for port improvement or expansion, and degradation of water quality are the most serious perturbations arising from port development. All have well recognized adverse impacts to living marine resources and habitat.

The introduction of exotic species and contaminated materials through ballast water release and exchange is an impact of port utilization. Ballast water is used by most ships for stability and maneuverability (Moyle 1991). The water is typically pumped into separate tanks used just for ballast or in empty cargo tanks when departing from port, and discharged when the ship takes on a cargo at another port. Evidence shows that hundreds of species of invertebrates have become established in exotic locales after being transported in ballast water (Moyle 1991). An infamous Atlantic coast example of a ballast water introduction is the zebra mussel (*Orreissena polymorha*).

Another hazard of port utilization is the potential for shipping accidents. Transportation of fossil fuels and other materials may result in major spills of oils and other hazardous materials (Hill 1996). Tributyl-tin, used in commercial anti-fouling paints, was formerly a major concern and has been largely banned, with the notable exception of aluminum hauled vessels (Foerster pers. comm.).

Construction activities associated with port development result in a loss of habitat diversity along the water's edge. Bulkheading, filling, and construction of port features result in general water quality degradation that reduces biotic diversity of important productive areas (USDC 1985a). Habitat types that are destroyed by construction of port infrastructure include: shallow bay bottom;

shoreline wetlands; seagrass meadows; and intertidal wetlands (Fehring 1983). The effect of loss of these habitats include loss of nursery area, reduction in water clarity, and shifts in primary productivity (Fehring 1983).

Measures for conservation and enhancement

The impacts of port development and utilization are caused by a need for infrastructure (i.e. filling of wetlands) and adequate channel depths (i.e. dredging and shoreline stabilization). Recommendations to minimize these impacts are located in sections 2.2.5.2.3, 2.2.5.2.4, and 2.2.5.3, respectively.

Impacts that are a result of shipping are addressed in the following recommendations:

A). To avoid introducing exotic species and toxic materials, ballast water should be exchanged beyond 200 miles or treated with chlorine or other toxicants. Procedures should be developed for monitoring ballast water. Factors controlling introduced species should be studied in species' native ecosystems (Moyle 1991).

B). All vessels transporting fuels and other hazardous materials should be required to carry equipment to contain and retrieve the spill.

C). Dispersants should not be used to clean up fuels and hazardous materials unless approved by the EPA/Coast Guard after consultation with fisheries agencies.

2.2.5.6 Marinas and recreational boating

As residential and commercial use of coastal lands increase, so does the recreational use of coastal waters. Marinas, public access landings, private piers, and boat ramps all vie for space. Boating requires navigational space, a place to berth for some boat owners, and boat yards for repair and storage.

Based on an annual average of 40 hours of cruising, the 10 million outboard and inboard/outboard powered pleasure boats in the U.S. impact as much water, fish eggs, larval and juvenile fish, and shellfish, as 800 nuclear and fossil fueled generating stations would in a year. Unfortunately, boating activity is concentrated in a short boating season that also occurs during the period of maximum biological activity in many estuaries (Stolpe 1997).

Marinas and recreational boating are increasingly popular uses of coastal areas. The growth of recreational boating, along with the growth of coastal development in general, has led to a growing awareness of the need to protect waterways. In the Coastal Zone Management Act (CZMA) of 1972, as amended, Congress declared that state coastal management programs provide for public access to the coasts for recreational purposes. Clearly, boating and adjunct activities (e.g., marinas) are an important means of public access. When these facilities are poorly planned or poorly managed, however, they may pose a threat to the health of aquatic systems (and may pose other environmental hazards; USEPA 1993). Since marinas are located right at the water's edge, there is often no buffering of the release of pollutants to waterways. Adverse environmental impacts may result from the following sources of pollution and activities associated with marinas and recreational boating (USEPA 1993):

1. Poorly flushed waterways where dissolved oxygen deficiencies exist;

2. Pollutants discharged from boats;

3. Pollutants transported in storm water runoff from parking lots, roofs, and other impervious surfaces;

4. The physical alteration or destruction of wetlands and of shellfish and other bottom communities during the construction of marinas, ramps, and related facilities; and

5. Pollutants generated from boat maintenance activities on land and in the water.

Impacts on the ecosystem that are caused by marinas include lowered dissolved oxygen, increased temperature, bioaccumulation of pollutants by organisms, water contamination, sediment contamination, resuspension of sediments, loss of SAV and estuarine vegetation, change in photosynthesis activity, change in the nature and type of sediment, loss of benthic organisms, eutrophication, change in circulation patterns, shoaling and shoreline erosion. Pollutants that result from marinas include nutrients, metals, petroleum hydrocarbons, pathogens, and polychlorinated biphenyls (USEPA 1993). Other contaminants introduced into surface waters originate from chemically treated timber used for piers and bulkheads. Commonly used chemicals are creosote and CCA (copper, chromium, and arsenic salts).

Other impacts of recreational boating are a result of improper sewage disposal, fish waste, fuel and oil spillage, cleaning fluids, and boat operation and maintenance (USEPA 1993).

According to the 1989 American Red Cross Boating Survey, there were approximately 19 million recreational boats in the United States (USEPA 1993). About 95 % of these boats were less than 26 feet in length. A very large number of these boats used a portable toilet, rather than a larger holding tank. Given the large percentage of smaller boats, facilities for the dumping of portable toilet waste should be provided at marinas that service significant numbers of boats under 26 feet in length (USEPA 1993).

The propellers from boats can also impact fish and fish habitat by direct damage to multiple life stages of organisms, including eggs, larvae, juveniles, and adults, as well as submerged aquatic vegetation (e.g., prop scarring); de-stratification (temperature and density which is characteristic of some estuaries; e.g., Pamlico Sound, North Carolina); elevated heat; and resuspension of sediments and increased turbidity (Stolpe 1997, Goldsborough 1997). The resuspension of bottom sediment can result in reintroduction of toxic substances into the water column. This may lead to increased turbidity, which can affect photosynthetic activity of algae and submerged aquatic vegetation (USEPA 1993). The SAV provides habitat for fish, shellfish, and waterfowl and plays an important role in maintaining water quality through assimilating nutrients. It also reduces wave energy, protecting shorelines and bottom habitats from erosion (USEPA 1993).

Fish waste can result in water quality problems at marinas with large numbers of fish landings or at marinas that have limited fish landings but poor flushing (USEPA 1993). The amount of fish waste disposed of into a small area such as a marina can exceed that existing naturally in the water at any one time. As fish waste decomposes, it requires oxygen, thus sufficient quantities of disposed fish waste can be a cause of dissolved oxygen depression, as well as odor problems (USEPA 1993).

Fuel and oil are commonly released into surface waters during fueling operations through the fuel tank air vents, during bilge pumping, and from spills directly into surface waters and into boats during fueling. Oil and grease from the operation and maintenance of inboard engines are a source of petroleum in bilges (USEPA 1993).

Marina employees and boat owners use a variety of boat cleaners, such as teak cleaners, fiberglass polishers, and detergents (USEPA 1993). Boats are cleaned over the water or onshore adjacent to the water. This results in a high probability of some of the cleaning material entering the water. Copper-based antifouling paint is released into marina waters when boat bottoms are cleaned in the water (USEPA 1993).

Measures for conservation and enhancement

The following measures were taken mainly from Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (USEPA 1993), unless otherwise specified.

A). Marina siting and design should allow for maximum flushing of the water supply for the site. Adequate flushing reduces the potential for the stagnation of water in a marina, helps to maintain the biological productivity, and reduces the potential for toxic accumulation in bottom sediment.

B). Water quality must be considered in the siting and design of both new and expanding marinas.

C). Marinas should be designed and located so as to protect against adverse impacts on shellfish resources, wetlands, submerged aquatic vegetation, and other important habitat areas as designated by local, state, or federal governments.

D). Where shoreline erosion is a nonpoint source pollution problem, shorelines should be stabilized. Vegetative methods are strongly preferred.

E). Runoff control strategies, which include the use of pollution prevention activities and the proper design of hull maintenance areas, should be implemented at marina sites. At least 80% of suspended solids must be removed from stormwater runoff coming from the hull maintenance areas. Marinas which obtain a NPDES permit for their hull maintenance areas are not required to conform to this hull maintenance area provision.

F). Fueling stations should be located and designed so that, in the case of an accident, spill contaminants can be contained in a limited area. Fueling stations should have fuel containment equipment, as well as a spill contingency plan.

G). To prevent the discharge of sewage directly to coastal waters, new and expanding marinas should install pumpout, pump station, and restroom facilities where needed.

H). Solid wastes produced by the operation, cleaning, maintenance, and repair of boats should be properly disposed of to limit their entry to surface waters.

I). Sound fish waste management should be promoted through a combination of fish cleaning restrictions, public education, and proper disposal.

J). Appropriate storage, transfer, containment, and disposal facilities for liquid materials commonly used in boat maintenance, along with the encouragement of recycling of these materials, should be required.

K). The amount of fuel and oil leakage from fuel tank air vents should be reduced.

L). Potentially harmful hull cleaners and bottom paints, and their release to marinas and coastal waters, should be minimized.

M). Public education/outreach/training programs should be instituted for boaters, as well as marina operators, to prevent improper disposal of polluting materials.

N). Pumpout facilities should be maintained in operational condition, and their use should be encouraged to reduce untreated sewage discharges to surface waters.

O). In shallow areas, intense boating activities may contribute to shoreline erosion. Increased turbidity and physical destruction of shallow-water habitat resulting from boating activities should be minimized.

P). Emissions from outboard motors should be monitored, and emissions standards should be enforced (Stolpe 1997).

Q). Dry stack storage marinas are recommended, as opposed to wet marinas, in bluefish EFH. Unlike wet marinas that require extensive dredging and other physical disruptions to physical habitats, dry stack storage facilities are located on uplands thereby minimizing the need for dredging and dependence on the use of timber treated with toxic chemicals. Additionally, land storage allows the use of polymer-based bottom paints, eliminating the need for toxic treatments containing copper or tributyl-tin.

2.2.5.7 Energy production and transport

Energy production facilities are widespread along Atlantic coastal areas. Electric power is generated by various methods, including land based nuclear power plants, hydroelectric plants, and fossil fuel stations. These facilities compete for space along the coastal zone and require water for cooling. The impacts on the marine and estuarine environment resulting from the various types of power plants include water consumption, heated water and reverse thermal shock, entrainment and impingement of organisms, discharge of heavy metals and biocides in blow down water, destruction and elimination of habitat, and disposal of dredged materials and fly ash (USDC 1985a).

2.2.5.7.1 Hydroelectric

Hydropower plants may alter the following characteristics of water bodies (Hill 1996):

1. Dissolved oxygen concentrations and temperature;

2. Create artificial destratification;

3. Withdraw or divert water;

4. Change sediment load;

5. Change channel morphology;

6. Accelerate eutrophication;

7. Change nutrient cycling; and

8. Contaminate water and sediment.

Water quality contaminants of major concern include: mercury; polychlorinated biphenyls; and organochlorine pesticides. Dams and the need for altered flows may substantially affect anadromous fish runs and/or restoration programs (Hill 1996). In addition, impingement of juvenile and adult fish may occur on trash racks that protect turbines from mechanical damage and turbine entrainment causes mortality of eggs and juvenile fishes. Altered dissolved oxygen levels can cause gas bubble disease to fishes (Hill 1996).

Habitat alterations include dams, which create reservoirs and tailwaters. Tailwaters can scour substrate and benthic organisms, as well as fish and fish eggs, create bank erosion, displace sediment downstream, and limit the establishment of riparian vegetation. In addition, clearing for hydropower projects requires disruption of wetlands and riparian habitat and control of some aquatic vegetation (Hill 1996).

2.2.5.7.2 Nuclear

A major adverse impact of nuclear power plants is water withdrawal and thermal pollution, due to the use of cooling water (Hill 1996). Once-through cooling which requires withdrawal of large volumes of water causes significant impingement of juveniles and larger size classes and entrainment of eggs and larvae. Reverse thermal shock can also occur when plant operation ceases, causing fish mortality to organisms that are adapted to the warmer outflow. As an alternative to once-through large-water volume usage, cooling towers can be constructed which reduce both impingement/entrainment and thermal pollution. Incidental use of biocides to reduce biofouling also introduces pollutants to the surface waters. Another problem is storage and disposal of nuclear wastes which will last centuries.

2.2.5.7.3 Fossil fuels

Coal- and oil-fired plants and shore based refineries are served by various sized vessels, which transport those fuels. Additional navigational channels may be required, that could result in habitat disruption initially and periodically, and the need to find appropriate sites for placement of dredged materials (USDC 1985a). Transportation of fossil fuels may risk the chance of major oil spills or release of other hazardous materials, increases in automotive emissions, and habitat loss from construction of pipelines (Hill 1996). Coal fired plants generate voluminous amounts of fly ash, sulfur dioxide, nitrogen oxides, carbon dioxide, and traces of mercury contributing to acid rain (USDC 1985a, Hill 1996). The excavation of fossil fuels may have adverse effects on biota, as well (Hill 1996). Mining can contribute to acid mine drainage, human health impacts, vegetation and associated wildlife losses, erosion and stream sediments (Hill 1996). In addition, water withdrawal and diversion may cause impingement and entrainment of fish, as well as thermal pollution (Hill 1996).

2.2.5.7.4 Offshore oil and gas operations

The Outer Continental Shelf (OCS) exploratory and production drilling and transport may affect biota and their habitats. Oil spills resulting from well blowouts, pipeline breaks, and tanker accidents are of major concern. Contaminants from oil exploration include mostly petroleum hydrocarbons and heavy metals. Effects of hydrocarbon contamination in the water column and sediments may include: mortality of larval fish; mortality from predation due to slower avoidance behavior; bioaccumulation in fish; migration interference for salmon and other anadromous species; and slower maturation of larvae (Howarth 1991). Sublethal effects can cause a decrease in recruitment, as well as complex ecological interactions (Howarth 1991). Cumulative effects of oil on ecosystems include changes in benthic community structure and possible changes in planktonic community structure (Howarth 1991). Oil and gas exploration in the Mineral Management

Service's (MMS) Mid-Atlantic, North Atlantic, and South Atlantic lease areas may result in loss or degradation of benthic habitat from the deposition of discharged drilling muds and cuttings. Should production of oil and gas occur in these areas, the transport of the products to onshore storage and processing facilities would pose additional threats to coastal zone and estuarine ecosystems (USDC 1985a).

Measures for conservation and enhancement

A). Appropriate measures should be taken to reduce acid precipitation and runoff into estuaries and nearshore waters.

B). Prior to pipeline construction, less damaging, alternative modes of oil and gas transportation should be explored (Penkal and Phillips 1984).

C). State natural resource agencies should be involved in the preliminary pipeline planning process to prevent violations of water quality and habitat protection laws and to minimize impact of pipeline construction and operation on aquatic resources (Penkal and Phillips 1984).

D). Potential effects of proposed and existing tidal power projects should be estimated; state and federal agencies regardless of their regulatory jurisdiction, should become involved in this process (Rulifson *et al.* 1986).

E). All vessels transporting fuels and other hazardous materials should be required to carry equipment to contain and retrieve the spill. Dispersants shall not be used to clean up fuels and hazardous materials unless approved by the EPA/Coast Guard and fishery agencies.

F). NPDES permit conditions, such as those relating to dissolved oxygen, temperature, impingement and entrainment, under the Clean Water Act, should be monitored and strictly enforced in bluefish EFH.

G). NPDES permits should be reviewed every five years for all energy production facilities.

H). Offshore oil and gas leasing, exploration, and production should be strictly limited and controlled, so as not to degrade bluefish EFH. Onshore facilities assisting offshore oil and gas exploration and development, and secondary development stimulated by OCS development, should not degrade bluefish EFH. Seismic work should not be carried out with explosives (air bursts only) in bluefish EFH.

I). Cooling towers, as opposed to once through cooling, should be used to reduce bluefish impingement and entrainment occurring bluefish EFH. To further reduce impingement and entrainment 0.1 in. (2-3 mm) wedge wire screens should be installed in intake pipes, with maximum intake velocity of 0-5 ft per second.

The following measures were taken from Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (USEPA 1993) and apply to dams 25 feet or more in height and greater than 15 acre-feet in capacity, or to dams six feet or more in height and greater that 50 acre-feet in capacity. They also apply only to those projects and activities that fall outside of existing jurisdiction of the NPDES permit program.

J). Erosion should be reduced and sediment retained onsite, to the extent practicable, during and after construction of dams. An approved erosion and sediment control plan, or similar administrative document that contains erosion and sediment control provisions, should be prepared and implemented prior to land disturbance.

K). Proper storage and disposal of certain chemicals, substances, and other materials that are used in construction or maintenance activities at dams, should be implemented. These include construction chemicals such as concrete additives, petrochemicals, solid wastes, cement washout, pesticides and fertilizers. Application, generation, and migration of toxic substances should be limited and properly stored and disposed. This measure also ensures that nutrients are applied at rates necessary to establish and maintain vegetation without causing significant nutrient runoff to surface waters.

L). Operation of dams should be assessed for impacts to surface water quality and instream and riparian habitat, and the potential for improvement should be evaluated. Significant nonpoint source pollution problems that exist from excessive surface water withdrawals should also be assessed and evaluated.

2.2.5.8 Sewage treatment and disposal

The Atlantic Ocean off the northeastern United States has been used in the past for the disposal of solid wastes and sewage sludge. Some waste treatment methods, such as chlorination, pose additional problems to aquatic species. Habitats and associated organisms have been degraded by long-term ocean disposal, particularly of sewage wastes. Sewage pollution causes closure of shellfish beds, and occasionally, of public swimming areas because of high fecal coliform counts. Dumping of sewage sludge in the Atlantic coastal waters is regulated under Section 102 of the Marine Protection and Sanctuaries Act, while the discharge of treated sewage effluent is permitted under Section 402 of the Clean Water Act.

Organic loading of estuarine and coastal waters is an emerging problem. Ocean disposal of sewage sludge degrades water quality and associated habitats. Symptoms of elevated levels include excessive algae blooms, shifts in abundance of algal species, increased biological oxygen demand (BOD) in sediments of heavily affected sites, and anoxic events in coastal waters. Changes in biological components are frequently a consequence of long-term ocean disposal. Harmful human pathogens and parasites can be found in biota and sediments in the vicinity of ocean dump sites. In 1995, 4.9 million acres of shellfish-growing waters was harvest- limited due to water quality (USDC 1997b). The top five pollution sources reported as contributing were urban runoff (40%), upstream sources (39%), wildlife (38%), individual wastewater treatment systems (32%), wastewater treatment plants (24%), and unknown (6%; USDC 1997a).

The Chesapeake Bay and the Hudson-Raritan Estuary are two of the three estuaries with the largest number of point discharges in the US (USDC 1993a). Most of the point sources of nutrient loading into the Hudson-Raritan Estuary are sewage treatment plants. In 1988, it was estimated that 6.8 million gallons per day of raw sewage were discharged into this estuary, mainly from Manhattan, Staten Island, and Brooklyn, contributing to most of the 50,000 tons of total nitrogen and 32,000 tons of total phosphorus added to the region per year. Wastewater treatment plants contributed 43% of the total nitrogen and 90% of the total phosphorus to the New York Bight (USDC 1993a). Toxics metals were added at a rate of 35,700 tons per year. Contributing to this loading was urban runoff (31%), wastewater treatment plants (19%), direct industrial discharge (14%), and various other sources.

Sewage treatment effluent produces changes in biological components as a result of chlorination and increased contaminant loading. Sewage treatment plants constructed where the soils are highly saturated often allow suburban expansion in areas that would have otherwise remained undeveloped, thereby exacerbating already severe pollution problems in some areas. Sewage treatment pollutant components include solids, phosphorus, and pathogens (USEPA 1993). Eutrophication in surface waters has also been attributed to the low nitrogen reductions provided by conventional onsite-disposal system.

Poorly designed or operating onsite disposal systems can cause ponding of partially treated sewage on the ground that can reach surface water through runoff. In addition to oxygen-demanding organics and nutrients, these surface sources contain bacteria and viruses that present problems to human health. Viral organisms can persist in temperatures as low as -20°F, suggesting that they may survive over winter in contaminated ice, later becoming available to ground water in the form of snowmelt (USEPA 1993). Although ground-water contamination from toxic substances is more often life-threatening, the majority of ground-water-related health complaints are associated with pathogens from septic tank systems (USEPA 1993).

While a variety of other wastes have been disposed of in coastal waters of the New York Bight for over 50 years, sewage sludge has only been dumped offshore of the New York Bight over the last 20 years (Chang 1993). Species abundances of silver and red hakes (*Merluccius bilinearis* and *Urophycis chuss*), summer flounder (*Paralichthys dentatus*), goosefish (*Lophius americanus*), and black sea bass (*Centropristis striata*) declined significantly over temporal and spatial scales during the disposal of contaminant laden sewage sludge at the deepwater 106-Mile Dump Site (Chang 1993). There was also a decline in the array of all aggregated species (Chang 1993).

Congress requested the Office of Technology Assessment (OTA) to assess the status of waste disposal in marine environments (OTA 1987). In general, OTA determined that estuarine and coastal waters were severely degraded across the nation and that "many of the adverse impacts on marine waters and organisms are caused by the introduction of pollutants through the disposal of wastes." These wastes include municipal sewage sludge, industrial wastes, dredged materials, industrial and municipal effluents, and urban and agricultural runoff. Based on their assessment, OTA concluded:

1. "Estuaries and coastal waters around the country receive the vast majority of pollutants introduced into marine environments. As a result, many of these waters have exhibited a variety of adverse impacts, and their overall health is declining or threatened;"

2. "In the absence of additional measures, new or continued degradation will occur in many estuaries and some coastal waters around the country during the next few decades (even in some areas that exhibited improvements in the past);"

3. "In contrast, the health of the open ocean generally appears to be better than that of estuaries and coastal waters. Relatively few impacts from waste disposal have been observed, partly because the open ocean has been subject to relatively little waste disposal and because wastes are typically dispersed and diluted. Uncertainty exists, however, about the ability to discern impacts in the open ocean". (Note, however, that studies which would detect these impacts in the open ocean have not been conducted.)

OTA (1987) determined that municipal and industrial discharges, sewage sludge, and dredged material accounted for most of the pollutants found in estuary and coastal waters along the Atlantic coast. OTA (1987) identified Buzzard's Bay, Boston Harbor, Narragansett Bay, Long Island Sound, the New York Bight, and Chesapeake Bay as specific areas that were severely polluted or degraded. Contaminated sediments, containing excessive concentrations of organic chemicals, metals and pathogens have been identified in Boston Harbor, New Bedford Harbor, the New York Bight, Raritan Bay, Hudson River Estuary, the Patapsco River around Baltimore, and the James River Estuary. Contaminated water and sediments in the North Atlantic have had adverse impacts on marine organisms. Fish kills, increases in fish diseases and abnormalities, and restrictions on commercial and recreational harvest of both finfish and shellfish have occurred as the result of this pollution (OTA 1987).

The dumping of sewage sludge is no longer allowed in the Atlantic Ocean. Historically, municipal sewage sludge and industrial waste were dumped in two areas along the North Atlantic coast: the New York Bight and deep water sites 100 miles east of Delaware Bay (OTA 1987). In 1985, approximately 7 million wet metric tons (15.4 million pounds) of municipal sewage sludge, several billion gallons of raw sewage, and 8 million wet metric tons (17.6 million pounds) of dredge spoils were dumped in the New York Bight. Routine dumping of municipal sewage sludge and dredge spoils probably contributed to the depletion of oxygen in the New York Bight during the summer and early autumn of 1976. Near anoxic and, in places, anoxic water was located approximately 4 miles off New Jersey and covered an area about 100 miles long and 40 miles wide during the most critical phases of oxygen depletion (Sharp 1976). The most commercially important species affected by the anoxia were surfclams, red hake, lobsters and crabs. Finfish were observed to be driven to inshore areas to escape the anoxia, or were trapped in water with concomitant high levels of hydrogen sulfide (Steimle 1976). These anoxic waters probably blocked the migration of medium bluefish, 3-12 pounds, north of New Jersey (Freeman and Turner 1977). Oxygen levels in 1985, in some areas of the Bight, approached the low values observed in 1976 (OTA 1987).

Measures for conservation and enhancement

A). All sewage should go through tertiary treatment (i.e., nutrient removal) when discharged in bluefish EFH.

B). Dechlorination facilities or lagoon effluent holding facilities should be used to destroy chlorine at sewage treatment plants and power plants.

C). All NPDES permits of public owned treatment works (POTWs) should be reviewed and strictly enforced in bluefish EFH.

2.2.5.9 Industrial wastewater and solid waste

Industrial wastewater effluent is regulated by USEPA through the NPDES/SPDES permitting program. This program provides for issuance of waste discharge permits as a means of identifying, defining, and controlling virtually all point source discharges. However, many problems remain due to inadequate monitoring and enforcement. It is not possible presently to estimate the singular, combined, and synergistic effects on the ecosystem impacted by industrial (and domestic) wastewater.

Point source discharges can potentially alter the following properties of communities and ecosystems: diversity, nutrient and energy transfer, productivity, biomass, density, stability, connectivity, species richness, and eveness (Cairns 1980). Additionally, point source discharges may alter the following characteristics of fish, shellfish, and related organisms: longevity, fecundity, growth, visual acuity, swimming speed, equilibrium, flavor, feeding rate, response time to stimuli, predation rate, photosynthetic rate, spawning season, migration route, and resistance to parasites. Contamination of water quality is generally due to organics and heavy metals, though other characteristics such as flow, pH, hardness, dissolved oxygen may also be altered (Cairns

1980).

Non-point discharges and solid wastes associated with industrial processes also contribute chemical contaminants to bluefish EFH. Chemicals can leak from storage facilities and leach from wastewater lagoons contaminating groundwater that ultimately discharge to rivers and estuaries. Solid wastes historically have been indiscriminately buried and, likewise, have contaminated groundwater with chemical leachates. Although regulatory programs have been enacted to preclude similar actions from occurring today, accidents still occur, and many areas are contaminated from past operations. Consequently, fish that inhabit waters adjacent to these sites, even seasonally, often bioaccumulate contaminants making them unfit for human consumption. Federal and state programs (e.g., Superfund) are designed to remediate hazardous waste sites, thereby reducing the bioavailability of contaminants to fish and other aquatic organisms. Unfortunately, remedial actions sometimes physically modify affected areas so completely that they are no longer suitable habitat for aquatic organisms.

Sediments and biota in specific areas along the Atlantic coast contain elevated levels of PCBs (OOMA 1987). High levels of PCBs found in bluefish sampled in coastal and estuarine waters of New Jersey (Belton *et al.* 1982) resulted in notices by the New Jersey Office of Cancer and Toxic Substances Research, which warned that bluefish should not be consumed by humans or, if eaten, cooked in manner to eliminate as much oily tissue as possible. Similarly, the Massachusetts Director of Public Health prohibited the taking of fish, including bluefish, from New Bedford Harbor because of PCB contamination.

A federal survey of PCBs in Atlantic coast bluefish was conducted by the NOAA in cooperation with the Food and Drug Administration and the Environmental Protection Agency (NOAA/FDA/EPA 1986). Bluefish were collected seasonally from 1984 to 1986 at 12 sites along the Atlantic coast from New England to Florida. Samples included fish in three size categories: small (less than 12" FL or approximately 13" TL), medium (12-20" FL or approximately 13-22" TL), and large (greater than 20" FL or approximately 22" TL). None of the small or medium fish collected at any site contained PCB concentrations which exceeded the FDA tolerance level of 2 parts per million (ppm) in edible fish. However, at every site, some large bluefish did exceed these levels. Greater than 45% of the large fish sampled from the New York Bight in October/November contained PCB in excess of 2 ppm. Similarly, more than 27% of the large bluefish collected from New England in August and greater than 23% of the large bluefish collected in North Carolina in April exceeded the FDA tolerance level.

The cooperating agencies recommended no action be taken regarding the interstate commerce of commercially caught bluefish (NOAA/FDA/EPA 1987). However, for anglers who repeatedly catch and eat bluefish, they recommended a maximum intake of 1.0×10^{-6} oz. of PCBs per 2 lbs. body weight per day. Based on their estimates of PCB intake by recreational fishermen, they indicated it was unnecessary to control human consumption of bluefish because the maximum intake would not be exceeded. However, the cooperating agencies recommended that public health authorities in each state should consider issuing health advisories to limit the amount of large bluefish that may be safely consumed by fishermen and their families.

Although PCBs are suspected carcinogens to humans, comprehensive research has not yet been done on the significance of elevated body burdens on the fish themselves, or on reproduction processes and subsequent recruitment of larval, juvenile, and pre-recruits to adult stocks. Whereas laboratory and field effects of a range of organic contaminants have been measured, there is little understanding of how contaminants such as PCBs affect the behavior, biochemistry, genetics, or physiology of these fish at either the lethal or sublethal level. It is significant that, where elevated levels of PCBs have been reported in the marine environment, they have generally been associated with elevated levels of toxic heavy metals, petroleum hydrocarbons, and other contaminants. It has often been speculated that PCBs may impact reproduction in bluefish, but definitive studies have not yet been performed.

The federal PCB study also assessed concentrations of organohalogen pesticides in bluefish collected along the coast. No significant concentrations of pesticide residues were found. However, from 1976 to 1988, the Virginia State Board of Health prohibited the taking, distribution, and consumption of bluefish from designated portions of the James River and its tributaries because of high concentrations of Kepone (chlordecone). The prohibition was removed in July 1988.

A recent study evaluated PCB levels in the serum of New Bedford, Massachusetts residents and in lobsters and bluefish from the same area (Burse *et al.* 1994). The presence of PCBs was confirmed both in serum samples and in bluefish and lobster samples.

The fin rot disease documented in bluefish by Mahoney *et al.* (1973) was from fish captured during the summers of every year from 1967 through 1973 in the New York Bight (Pottern *et al.* 1989). Bacteria of the genera *Aeromonas*, *Vibrio*, and *Pseudomonas* were isolated from fish (including flounder) showing chronic fin necrosis, skin hemorrhage, ulcers and blindness. The authors suggest that heavy metal contaminants (copper, zinc, chromium and lead were measured in high concentration in the area) weakened the fishes' immune response to such facultative pathogenic bacteria, which were also present in unusually high concentrations, due to poorly treated municipal and industrial sewage discharge. Laboratory controls which employed sewage without heavy metals did not induce disease.

Concentration of metals in bluefish liver tissue was found to be positively correlated with body size (Mears and Eisler 1977). Cross *et al.* (1973) found a similar relationship for metal accumulation in bluefish white muscle tissue (Pottern *et al.* 1989).

Bluefish are well adapted as a result of their behavioral repertoire to avoid unfavorable conditions, but avoidance depends on the fishes' ability to detect contaminants and recognize them as hazardous, as well as upon the motivation for fish to be in a contaminated area (Olla and Studholme 1975, Pottern *et al.* 1989). If spawning or nursery areas are contaminated, or migration routes are thermally or chemically "blocked", and if contamination is present in prey, then avoidance may be impossible.

Measures for conservation and enhancement

A). No toxic substances in concentrations harmful (synergistically or otherwise) to humans, fish, wildlife, and aquatic life should be discharged. The EPA's Water Quality Criteria Series should be used as guidelines for determining harmful concentration levels. Use of the best available technology to control industrial waste water discharges should be required in areas essential for the survival of bluefish. Any new potential discharge into bluefish EFH must be shown not to have a harmful effect on bluefish.

B). The siting of industries requiring water diversion and large volume water withdrawals should be avoided in bluefish EFH. Project proponents should demonstrate that project implementation will not negatively affect bluefish, its EFH, or its food supply. Where such facilities currently exist, best management practices must be employed to minimize adverse effects on the environment.

C). All NPDES permits should be reviewed and strictly enforced in bluefish EFH.

D). Hazardous waste sites should be cleaned up (i.e., remediated) to prevent contaminants from entering aquatic food chains.

E). Remedial actions affecting aquatic and wetland habitats should be designed to facilitate restoration of ecological functions and values.

2.2.5.10 Marine mining

Mining for sand, gravel, shell stock, and beach nourishment projects in coastal and estuarine waters can result in the loss of infaunal benthic organisms, modifications of substrate, changes in circulation patterns, and decreased dissolved oxygen concentrations at deeply excavated sites where flushing is minimal (USDC 1997a). Marine mining elevates suspended materials at mining sites, and turbidity plumes may move several miles from individual sites. Resuspended sediments may contain contaminants such as heavy metals, pesticides, herbicides, and other toxins. Mining also results in changes in sediment type or sediment quality, often over areas measurable in square miles. Deep borrow pits created by mining may become seasonally or permanently anaerobic. Finfish appear to seek out these warmer pockets in the late fall, possibly as a result of declining water temperatures in surrounding area (Ludwig and Gould 1988). It may be important for beach nourishment projects to avoid areas that are rich in clam shells or near other "reef" habitats (Steimle pers. comm.).

Deep ocean extraction of mineral nodules is a possibility for some non-renewable minerals now facing depletion on land. Such operations are proposed for the deep ocean proper, where nodules are bedded on oceanic oozes. Resuspension of these oceanic oozes can affect water clarity over wide areas and, if roiled to the near-surface, could also affect photosynthetic activity. Nodule concentrations have been located along the slope/ocean deep zone in Georgia and the Carolinas (Ludwig and Gould 1988). Such mining activities could potentially affect benthic organisms and their habitats, as well as pelagic eggs and larvae (USDC 1985a).

Measures for conservation and enhancement

A). Sand mining and beach nourishment should not be allowed in bluefish EFH during seasons when bluefish are utilizing the area.

The following are applicable to freshwater situations and are recommendations taken from the NMFS National Gravel Extraction Policy (USDC 1996a).

B). Gravel extraction operations should be managed to avoid or minimize impacts to bathymetric structure in estuarine and nearshore areas.

C). The cumulative impacts of gravel and sand extraction should be addressed by federal and state resource management and permitting agencies and considered in the permitting process.

D). An integrated environmental assessment, management, and monitoring program should be a part of any gravel or sand extraction operation, and encouraged at federal and state levels.

E). Plan and design mining activities to avoid significant resource areas (such as consolidated sand ledges, sand dollar beds, or algae beds).

F). Plan and design mining activities with minimum area and depth to minimize recolonization times (deep holes should be avoided).

G). Mitigation and restoration should be an integral part of the management of gravel and sand extraction policies.

H). Remove unlike material as part of the mining operation to help restore natural bottom characteristics.

I). Remove material from areas where accumulation is caused by human activities.

J). Return gravel to stream areas needing such for additional spawning.

2.2.5.11 Aquaculture

Aquaculture is an expanding industry in the US. The annual commercial harvest is over 700 million lbs round weight with a value to producers of nearly $600 million (Robinette *et al.* 1991). The commercial culture of channel catfish, salmonids, and crayfish is very successful, and the potential commercial culture of other species is being explored. Most aquaculture facilities are located in farmland, tidal, intertidal, and coastal areas (Robinette *et al.* 1991). Major potential adverse impacts of aquaculture include disease, genetic pollution of wild stock, escape of exotic species, water contamination, and eutrophication (Robinette *et al.* 1991). Also, the use of low-head dams, weirs, and other obstructions may impede the natural movement of estuarine species (Robinette *et al.* 1991).

Escape of exotic species may result in a restructuring of the native ecosystem through such pathways as gene pool deterioration, trophic alteration, introduction of pathogens and disease, and displacement of native species through competition (these impacts of exotic species are discussed separately in section 2.2.5.12; Robinette *et al.* 1991). Cultured species may be genetically altered and/or have a less genetically diverse background than wild species. The release of the reared stock may have an adverse impact to the wild stock. For example, a reared stock may be less resistant to a disease than a wild stock. When the two stocks begin to mix it may lower the resistance of the native stock to the disease (Sindermann 1992).

Measures for conservation and enhancement

The following recommendations are taken from The American Fisheries Society (AFS) Position Statement of Commercial Aquaculture (Robinette *et al.* 1991).

A). Federal and state agencies should cooperatively promulgate and enforce regulations to ensure both the health of the aquatic organism and quality of the food products. Animals that are to be moved from one biogeographic area to another or to natural waters should be quarantined to prevent disease transmission.

B). To prevent disruption of natural aquatic communities, cultured organisms should not be allowed to escape, and the use of organisms native to each facility's region is strongly encouraged.

C). When commercially cultured fish are considered for stocking in natural waters, every consideration should be given to protecting the genetic integrity of native fishes.

D). Aquaculture facilities should meet prevailing environmental standards for wastewater treatment and sludge control.

2.2.5.12 Ocean disposal

Ocean disposal of industrial waste products, dredged material, and radioactive wastes degrades water quality and associated habitats. Concentrations of heavy metals, pesticides, insecticides, petroleum products, and other toxic contaminants contribute significantly to degradation of waters off the Atlantic coast. Changes in biological components are a consequence of long-term ocean disposal. Harmful human pathogens and parasites can be found in biota and sediments in the vicinity of ocean dump sites. In addition, shellfish harvesting grounds have been closed because of excessive concentrations of pathogenic and indicator species of bacteria.

Many of the above issues and concerns may also be germane to the dumping of fish and shellfish waste in the ocean. The closure of land based processing plants because of the inability to meet NPDES/SPDES effluent requirements encourages the attempts for at sea disposal. While fishery byproducts may be nutritive in value, problems of biological oxygen demand (BOD) increases, excessive algal blooms, and concentrations of pathogenic bacteria, may all be associated with ocean disposal of fisheries products.

Measures for conservation and enhancement

Note: this threat was a major concern to NMFS habitat researchers and the Council members in the mid to the late 1980s. Through concerted efforts of numerous individuals and agencies, ocean disposal has presently ceased; however, discussions still persist relative to resuming dumping. Should ocean disposal ever become viable again, the Council policy (MAFMC 1990b) should be reviewed.

A). Under no circumstances should there be disposal of contaminated material in EFH (section 2.2.5.4.D). All of the other recommendations for dredging and disposal of dredged materials (section 2.2.5.4) apply here as well.

B). Ocean disposal of fresh fish waste (i.e., scallop shells and bodies, fish racks, etc.) shall be permitted in areas that are not environmentally at risk. Monitoring of the disposal area will be the responsibility of the discharger if there is credible scientific information that suggest the area is being negatively impacted by the discharge.

2.2.5.13 Introduced species

Over the past two decades there has been an increase in introduction of exotic species into aquatic habitats (Kohler and Courtenay 1988). Introductions can be intentional (e.g., for purpose of stocking or pest control) or unintentional (e.g., fouling organisms). Five types of negative impacts generally occur due to species introductions: (1) habitat alteration; (2) trophic alteration; (3) gene pool alteration; (4) spatial alteration; and (5) introduction of diseases. Habitat alteration includes the excessive vegetation of introduced aquatic plants (e.g. hydrilla, watermilfoil, and alligator weed (Kohler and Courtenay 1988). This overgrowth interferes with swimming and fishing activities, upsets predator-prey relationships, and causes water quality problems. The introduction of exotic species may alter community structure by predation on native species (e.g. brown trout on brook trout) or by population explosions of the introduced species (e.g. tilapias). Spatial alteration occurs when territorial introduced species compete with native species (e.g. displacement of brook trout by brown trout). Although hybridization is rare, gene pool deterioration may occur between native and introduced species (e.g. brown trout and brook trout). One of the most severe threats to a native fish community is the bacteria, viruses, and parasites that can be introduced with exotic species (Kohler and Courtenay 1988).

Escape of exotic species may result in a restructuring of the native ecosystem through such pathways as gene pool deterioration, trophic alteration, introduction of pathogens and disease, and displacement of native species through competition (Robinette *et al.* 1991). Cultured species may be genetically altered and/or have a less genetically diverse background than wild species. The release of the reared stock may have an adverse impact to the wild stock. For example, a reared stock may be less resistant to a disease than a wild stock. When the two stocks begin to mix it may lower the resistance of the native stock to the disease (Sindermann 1992).

Measures for conservation and enhancement

The following recommendations are taken from the AFS Position Statement on Introductions of Aquatic Species (Kohler and Courtenay 1986).

A). Fish importers, farmers, dealers, and hobbyists should prevent and discourage the accidental or purposeful introduction of aquatic species into their local ecosystems.

B). City, county, state or federal agencies should not introduce species into any waters within its jurisdiction which might contaminate any waters outside its jurisdiction.

C). Only ornamental aquarium fish dealers should be permitted to import such fishes for sale or distribution to hobbyists.

D). The importation of fishes for purposes of research not involving introduction into a natural ecosystem should be made with the responsible government agencies.

E). All species that are considered for release should be prohibited and considered undesirable for any purpose of introduction into any ecosystem unless found to be desirable by federal fisheries agencies, as well as neighboring state agencies .

2.2.5.14 Cumulative impact analysis

According to section 600.815 (a)(6), to the extent feasible and practicable, FMPs should analyze how fishing and non-fishing activities influence habitat function on an ecosystem or watershed scale.

Cumulative impacts to the environment that result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of who undertakes such actions. Several examples of cumulative impacts from non-fishing and fishing threats include wetland losses, nutrient enrichment, eutrophication, toxic algal blooms, and global climate change. These cumulative impacts generally occur in estuarine and inshore areas, and the multiple effects can result in adverse impacts to bluefish EFH.

Estuaries provide the nation with highly productive habitats and important living resources. Intensive use of these ecosystems for industrial, residential, and recreational activities has had cumulative adverse effects on many estuarine resources. Fifty-two estuaries have been designated as bluefish EFH (Table 10).

The Mid-Atlantic region extends from New York through North Carolina. However, Mid-Atlantic

Fishery Management Council manages species throughout their range, which for bluefish includes the entire U.S. Atlantic coast. The National Estuarine Inventory defines 15 estuaries in the Mid-Atlantic States including: Gardiner's Bay, Long Island Sound, Great South Bay, Hudson-Raritan Bay, Barnegat Bay, New Jersey Inland Bays, Delaware Bay, Delaware Inland Bays, Chincoteague Bay, Chesapeake Bay, Albemarle Sound, Pamlico Sound, Bogue Sound, New River, and Cape Fear River (USDC 1990). Mid-Atlantic estuaries account for 44% of the total freshwater discharge to coastal waters along the Atlantic coast. Yearly precipitation amounts to 40 to 48 inches per year. However, peak freshwater flow is a result of spring snow melt (USDC 1990).

Human use of estuaries in the Mid-Atlantic is extensive and described earlier in section 2.2.5. These problems have begun to be addressed. However, conclusions about the cumulative effects of contaminants is lacking on the ecosystem and the fifty-two estuaries (Table 10 and Figures 16 and 17) that were established as bluefish EFH, along with much of the inshore area of the Atlantic coast (Figures 18-21). Many of the bluefish prey species are estuarine dependent (Table 4). Although not quantified, cumulative impacts to estuarine and inshore areas may have potential impacts to the sustainability of the bluefish fishery.

2.2.5.14.1 Nutrient loading

Land use intensification threatens efficient nutrient cycling in many watersheds. Excess nutrients from land based activities accumulate in the soil, pollute the atmosphere, pollute ground water, or move into streams. Healthy watersheds have a reasonable balance of nutrient imports and exports (Aschman *et al.* 1997). Physical characteristics and nutrient loadings of eight of the major mid-Atlantic estuaries are summarized in Table 20. Five of eight of these estuaries have medium to high nutrient loadings. Nutrient inputs include a combination of urban and industrial sources (Mid-Atlantic Regional Research Program 1994). Nutrient inputs to these mid-Atlantic estuaries include sewage input (septic systems and wastewater treatment), industrial wastewater, urban input, agricultural sources, and atmospheric inputs.

Of course while nutrient overloading is a significant problem in many areas, nutrients are necessary for overall productivity. It is speculated by some that chemosynthesis from deep sea trenches is perhaps the largest input of nutrients into the marine system. (Fletcher pers. comm.). While worldwide, chemosynthesis may be very important in the oceans' productivity, it does not appear that significant nutrients are contributed from deep sea trenches to areas currently designated as bluefish EFH.

Measures for conservation and enhancement

Nutrient loading is a cumulative impact that results from the individual threats of coastal development, nonpoint source pollution, marinas and recreational boating, sewage treatment and disposal, industrial wastewater and solid wastes, ocean disposal and aquaculture. Please refer to the above sections for individual measures for conservation and enhancement.

2.2.5.14.2 Eutrophication

Nutrient inputs are known to have a direct effect on water quality. For example, in extreme conditions excess nutrients can stimulate excessive algal blooms that can lead to increased metabolism and turbidity, decreased dissolved oxygen, and changes in community structure, a condition called eutrophication (NOAA 1996, 1997a,b). Office of Ocean Resources Conservation and Assessment (ORCA) initiated the Estuarine Eutrophication Survey in 1992 to comprehensively assess the scale and scope of nutrient enrichment and eutrophication in the National Estuarine

Inventory estuaries. Table 21 illustrates the results of the eutrophication survey for the Atlantic coast, collected through a series of surveys, interviews, and regional workshops. The surveys describe existing conditions and trends of 17 parameters that characterize nutrient enrichment (NOAA 1996, 1997a,b).

Measures for conservation and enhancement

Eutrophication is a cumulative impact that results from the individual threats of coastal development, nonpoint source pollution, marinas and recreational boating, sewage treatment and disposal, industrial wastewater and solid wastes, ocean disposal and aquaculture. Please refer to the above sections for individual measures for conservation and enhancement.

2.2.5.14.3 Harmful algal blooms

It is believed that nutrient enrichment of estuarine waters has lead to blooms of noxious dinoflagellates and algae (Mid-Atlantic Regional Marine Research Program 1994). Examples of such dinoflagellates or algae include *Gynodinium breve,* the dinoflagellate that causes neurotoxic shellfish poisoning, dinoflagellates of the genus *Alexandrium,* which causes paralytic shellfish poisoning, *Aureococcus anophagefferens,* the algae which causes "Brown tide", and diatoms of the genus *Pseudo-nitzschia,* which cause amnesic shellfish poisoning (Boesch *et al.* 1997).

Brown tide has been a recurrent problem in Peconic/Flanders and South Shore Bays of Long Island, since 1985 (Suffolk County DOHS 1997). It has also occurred in Narragansett Bay, Rhode Island and Barnegat Bay, New Jersey. Among finfish and shellfish that have been impacted by brown tide, the scallop population in the Peconic Estuary has been virtually eradicated (Suffolk County DOHS 1997). The causes of the impact of brown tide are still unknown and may be attributed to toxic, mechanical, and/or nutritional aspects of the organism. However, when brown tide blooms exist at concentrations greater than 200,000 to 250,000 cells per 0.06 cu. in. (1 ml), it reduces light penetration adversely impacting eelgrass beds, which are of critical importance to finfish and shellfish (Suffolk County DOHS 1997). Although macro-nutrients do not cause blooms, they may provide optimum conditions for it.

Pfiesteria piscicida is a recently-described toxic dinoflagellate that was originally isolated from North Carolina waters (FDEP 1998). It has been documented in the water column in Delaware, Maryland, and North Carolina. Another *Pfiesteria*-like organism has been documented in St. John's River, Florida. *P. piscicida* has been associated with fish kills in North Carolina and Maryland (FDEP 1997, Hughes Commission 1997). Although *Pfiesteria* has been documented in Maryland waters, and fish with lesions were found in those same waters, etiologies of those lesions is still unknown, and is currently being studied by state, federal, and university pathologists (Driscoll pers. comm.). Additionally, the role of nutrient runoff and other possible causes are being investigated (Driscoll pers. comm.).

The role of nutrients in algal blooms around the world is well documented (Hughes Commission 1997). *Pfiesteria* has a complicated life cycle (Figure 32), and the role that nutrients play in that life cycle is still unknown. Dr. Joanne Burkholder, who is credited with the discovery of *Pfiesteria,* has demonstrated in the laboratory that the growth of non-toxic stages of *Pfiesteria* can be stimulated by the addition of inorganic and organic nutrients. Field studies conducted by Burkholder have demonstrated a correlation between phosphorous-rich waste outfalls and high concentrations of non-toxic *Pfiesteria* (Hughes Commission Report 1997). It is important to note that not all outbreaks of *Pfiesteria* occurred in nutrient-enriched waters. Currently, it is not known what triggers *Pfiesteria* to a toxic stage. High nutrient concentrations are not required for *Pfiesteria* or *Pfiesteria*-like dinoflagellates to turn toxic. In fact, if suitable concentrations are present, toxic outbreaks can occur even if nutrient concentrations are relatively low. It appears that excessive nutrient loadings can help to create an environment rich in microbial prey and organic matter that *Pfiesteria* uses as a food supply (Hughes Commission 1997). Some scientists hypothesize that the primary stimuli for the transformation of the dinoflagellate into toxic stages are chemical cues secreted or excreted by the fish. In other words, fish must be present for a toxic outbreak to occur (Hughes Commission 1997).

Measures for conservation and enhancement

A). Federal and state agencies should address the issue of harmful algal blooms and *Pfiesteria*-like toxins which cause adverse effects in bluefish EFH.

2.2.5.14.4 Wetland Loss

In the late 1970's and early 1980's the country was losing wetlands at an estimated rate of 300,000 acres per year. The Clean Water Act and state wetland protection programs have helped to decrease wetland losses to 117,000 acres per year, between 1985 and 1995 (Dahl *et al.* 1997). Estimates of wetlands loss differ according to agency. USDA estimates attributes 57% wetland loss to development, 20% to agriculture, 13% to deepwater habitat, and 10% to forest land, rangeland, and other uses (USDA 1995). Of the wetlands lost to uplands between 1985 and 1995, USFWS estimates that 79% wetlands were lost to upland agriculture. Urban development and "other" types of land use activities were responsible for 6% and 15%, respectively (Dahl *et al.* 1997). Strong wetland protection must continue to be a national priority; otherwise, fisheries that support more than a million jobs and contribute billions of dollars to the national economy are at risk (Stedman and Hanson 1997).

Minton (1997) describes the importance of wetlands to bluefish as habitat (Table 22). A direct link between wetland energy flows and fisheries harvest has never been established (Goodger pers. comm.). However, the life cycles of most fish and shellfish are fairly well understood, and biologists have determined that wetlands play an important part in providing food, protection, and spawning areas for a number of species (Stedman and Hanson 1997).

Despite the urbanized nature of the mid-Atlantic, it contains more than 3,500 square miles of wetlands (Stedman and Hanson 1997). The Chesapeake and Delaware Bays have the first and second highest areas of wetlands in the region, respectively. Forested wetlands are the most common type of wetland, accounting for nearly 58% of the region's wetlands, followed by salt marsh (28%; Stedman and Hanson 1997).

Measures for conservation and enhancement

Wetland loss is a cumulative impact that results from the individual threats of coastal development, dredging and dredge spoil placement, port development, marinas and recreational boating, sewage treatment and disposal, industrial wastewater and solid wastes, ocean disposal, marine mining, and aquaculture. Please refer to the above sections for individual measures for conservation and enhancement.

2.2.5.14.5 Global climate change

Global warming, an indirect impact of population growth, is an accumulation of carbon dioxide and other gases, such as methane, that trap solar infrared light in the atmosphere causing a warming trend. These gases originate from industrial and residential sources. Although the issue of global warming is controversial, all models predict some warming, especially in the higher latitudes in the northern hemisphere (Thorne-Miller and Catena 1991).

While the rise of the ocean temperature may not be as dramatic or as fast as the atmosphere, only a degree or two can have a dramatic effect on biological communities (Thorne-Miller and Catena 1991). Another potential affect will be sea level rise caused by the melting of the Arctic tundra and ice cap. Among the possible effects on sea life are: (1) a significant loss of coral reefs, salt marshes, and mangrove swamps unable to keep up with a rapid rise in sea level; (2) loss of species whose temperature tolerance range is exceeded (perhaps an even greater threat to corals than sea-level rise); (3) effects from Tundra runoff including runoff of nutrients and suspended sediments; and (4) saltwater intrusion that wreaks havoc with freshwater ecosystems, including rivers, freshwater marshes, and coastal lowland farm acreage (Thorne-Miller and Catena 1991). Other effects that may result from the melting of the Arctic tundra, include: (1) warmer water species would invade formerly cooler habitats confining cooler habitat species farther north; and (2) physical changes in the Arctic Seas that may have repercussions through oceans worldwide by altering the patterns of circulation, food chains that include valuable fisheries, and climate in other part of the world (Thorne-Miller and Catena 1991).

The Department of Commerce reports that human-generated increases in greenhouse gas concentrations have combined with natural forces to cause unprecedented warming in the Arctic in the 20th century, a phenomenon that could lead to significant changes in the earth's natural environment (USDC 1997c). Between 1840 and the mid-20th century, the Arctic warmed to the highest levels of the past four centuries, causing dramatic retreats of glaciers, thawing of permafrost and sea ice, and changes in terrestrial and lake ecosystems (USDC 1997c). Significant warming in the Arctic, particularly after 1920, may also be related to increased solar irradiance, decreased volcanic activity, and factors internal to the climate system (USDC 1997c).

As a result of changing meteorological conditions and sea level rise, fish habitats, fishery yields, and the industry's shoreline infrastructure could change dramatically (Bigford 1991). The projected average range of global sea level rise over the next century has been adjusted down since the mid-1980's, but still ranges from about 20 to 78 in. (50 to 200 cm). At least three factors will determine the severity of impacts from sea-level rise on natural resources and their habitat: (1) physical obstruction to inland habitat shifts from natural or human barriers; (2) resilience of species to withstand new environmental conditions during periods of erosion-induced transition; and (3) the rate of environmental change (Bigford 1991). Also sea-level rise could affect species distributions and abundance, particularly for estuarine-dependent or wetland dependent species.

2.2.5.15 Legislation and regulations that currently address habitat issues

Many federal laws are designed to regulate activities that have the potential to adversely affect the environment. Frequently, state programs complement those of the federal government. However, it is not the intent of this discussion to provide a comprehensive description of all these programs, but rather focus attention on those that most directly affect fisheries resources and their associated habitats. Those programs in which NMFS participate are emphasized because NMFS is specifically charged with conserving, enhancing, and managing living marine resources and, in concert with the Councils, implementing provisions of the MSFCMA.

Consultative authority is conferred to NMFS by several laws [e.g., Fish and Wildlife Coordination Act (FWCA), the National Environmental Policy Act (NEPA), the Marine Mammal Protection Act (MMPA), and the Endangered Species Act (ESA)]. These laws require federal agencies to consult with NMFS when proposing to construct, operate, authorize, or fund any activity that may affect resources within the purview of NMFS (e.g., fisheries resources, some marine mammals and endangered species, and their respective habitats). These mandates are essential to NMFS when reviewing proposals requiring permits to modify estuarine and marine habitats, such as those regulated by the Section 10/404 program.

Section 10 of the River and Harbor Act of 1899 authorizes the Army Corps of Engineers (COE) to regulate activities in navigable waters (to mean high water shoreline). Section 404 of the Clean Water Act (CWA), as amended, authorizes COE to regulate the discharge of dredged or fill materials in waters of the United States, including wetlands. EPA exercises oversight of the corps through establishment of guidelines under Section 404(b)(1) and the ability to veto permit decisions under section 404(c). The COE must consult with NMFS, and consider any recommendation made by them, before making a permit decision. It is through these recommendations that NMFS has the opportunity to alleviate potential adverse impacts associated with project implementation.

NMFS may also use its consultative authorities when reviewing other activities that can affect aquatic habitats. For example, Section 402 of CWA authorizes EPA, or delegated states with approved programs, to regulate the discharge of all industrial and municipal wastes (i.e., point source discharges). The EPA and COE also share regulatory responsibilities under the Marine Protection, Research, and Sanctuaries Act (MPRSA) for the discharge of wastes into ocean waters. The COE specifically regulates the discharge of dredged materials, while EPA regulates other discharges (e.g., municipal sewage sludge, industrial wastes). MPRSA also directs NOAA to conduct research and establish marine sanctuaries, which have habitat applications, as do elements of the Coastal Zone Management Act (CZMA).

Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) requires states with approved Coastal Zone Management Programs to address nonpoint pollution in coastal waters. States must submit Coastal Nonpoint Pollution Control Programs for approval to both the EPA and the NOAA. EPA published "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters" to assist states to achieve compliance with CZARA. States failing to comply with Section 6217 may lose part of their federal funding under Section 306 of CZMA and Section 319 of CWA.

Other provisions of CWA enable NMFS to exercise its consultative authorities to conserve and enhance living marine resources and habitat. For example, Section 316 (a) and (b) require power plants to address and abate thermal pollution, and entrainment and impingement of organisms, respectively, and Section 303 requires states to address water quality holistically by watershed. Total Maximum Daily Loads (TMDLs) have been established for key pollutants (e.g., some heavy metals, nutrients) under Section 303. Stream segments within each watershed are then monitored, and abatement plans are developed so that each watershed can be brought into compliance with TMDLs.

Section 320 of the CWA authorizes the National Estuary Program (NEP). Currently, 28 estuaries are included in the NEP nationally; 8 in the Mid-Atlantic. Habitat loss and modification and eutrophication have been identified as major problems affecting Mid-Atlantic estuaries. Comprehensive Conservation and Management Plans (CCMPs) have been developed that address the problems affecting these estuaries, describe measures needed to resolve these problems, and provide implementation strategies. Plans are also developed to monitor the success of plan implementation. NMFS participates on the Scientific and Technical Committees (STACs) and Living Resources Subcommittees (LRSCs) of many of these estuaries recommending research needed to understand estuarine processes and problems, assisting in the development of CCMPs, and facilitating their implementation.

Some laws, such as the Federal Power Act, as amended, provide NMFS with the authority to prescribe mitigative measures (e.g., construction of fish passage facilities) for projects licensed by the Federal Energy Regulatory Commission. In the northeast, prescriptive authority is primarily used to retrofit facilities that injured resources resulting from past actions, such as requiring construction of fishways on existing hydroelectric plants during relicensing evaluations. Other legislation mandating NMFS to mitigate resource injuries through restoration or replacement of equivalent services are found in the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund) and Oil Pollution Act.

Additionally, NMFS is involved in programs (e.g., Saltonstall-Kennedy, Anadromous Fish Act) that provide grants for the implementation of studies that contribute to the conservation of fish and habitats, or improve fisheries management.

The MSFCMA interim final rule requires consultation between NMFS and other state and federal agencies regarding EFH. Federal agencies are required to respond to NMFS and Council comments on federal activities, including those that are federally authorized or funded. State and federal agencies are encouraged to coordinate with NMFS and the Council in the early stages of actions to identify potential impacts to EFH.

Other pertinent legislation affecting the protection, conservation, enhancement, and management of living marine resources and habitat can be found in *A Plan to Strengthen the National Marine Fisheries Service's National Habitat Program* (USDC 1996b).

2.2.6 Prey Species

According to section 600.815 (a)(8), actions that reduce the availability of a major prey species, either through direct harm or capture, or through adverse impacts to the prey species' habitat that are known to cause a reduction in the population of the prey species may be considered adverse effects on a managed species and its EFH. The bulk of this information can be found in section 2.1.3.5 Food and feeding.

In summary, bluefish are very non-selective predators; however, several of their prey items are estuarine dependent. Conservation and enhancement recommendations (section 2.2.5) address degradation in estuarine areas for bluefish and their food sources.

2.2.7 Research and Information Needs

Section 600.815 (a)(10) states that each FMP should contain recommendations for research efforts that the Councils and NMFS view as necessary for carrying out their EFH management mandate. There are four sets of recommendations included in this section.

In general, there is a necessity to review the unpublished "grey" literature from organizations such as Sea Grant, state and federal agencies, educational institutions, consulting firms, etc. where significant research has been performed on fisheries related contaminant data. However, the time frame imposed by Congress did not permit for a complete review of this data. Review of existing information should provide a logical first step for management and better define and prioritize research needs.

The four sets of recommendations in this section are simply a compilation of all existing data needs.

The Council stands ready to work with NMFS to prioritize these needs on a coastwide basis. The Council is soliciting input from the public during the hearing process as to their view of prioritization.

The first set of recommendations comes from the Bluefish FMP (MAFMC 1990a). It states that the National Status and Trends Program of NOAA (OOMA 1987) should assist in making intelligent decisions involving the use and allocation of resources in the nation's coastal and estuarine regions. These decisions require reliable and continuous information about the status and trends of environmental quality in the marine environment. Four general objectives were established for the early years of the National Status and Trends Program (OOMA 1987). Those objectives were: (1) to establish a national data base using state of the art sampling, preservation, and analysis methodologies; (2) to use the information in the data base to estimate environmental quality, to establish a statistical basis for detecting spatial and temporal change, and to identify areas of the nation that might benefit from more intensive study; (3) to seek and validate additional measurement techniques, especially those that describe a biological response to the presence of contaminants; and (4) to create a cryogenic, archival specimen bank containing environmental samples collected and preserved through techniques that will permit reliable analysis over a period of decades. While the Council concurs with these objectives, efforts by this program or other NMFS programs also must look at specific issues which include:

1. It is necessary that scientific investigations be conducted on bluefish to emphasize the long-term, synergistic effects of combinations of environmental variables on, for example, reproductive capability, genetic changes, and suitability for human consumption.

2. The Councils recommend the following areas for future habitat directed investigations: field studies on the direct and indirect effects of contaminants on mortality of bluefish; studies on the interactive effects of pH, contaminants, and other environmental variables on survival of bluefish; and continued studies on the importance of factors controlling the production and distribution of food items that appear in the diet of young bluefish.

The second set of recommendations comes from Fahay (1998), where it is stated that information is lacking on the reproductive biology of bluefish. Observed patterns of spawning may be based on the population level, rather than on information on individual reproductive traits. It is not presently known whether individuals spawn serially or, if so, how many times they may be capable of spawning in a year. We also do not know if these reproductive characteristics vary with age. It is apparent that more study of the distribution of older stages needs to be correlated with spawning events. Since bluefish school in like-sized (and supposedly like-aged) groups, we need to know what groups are where and when and how those aggregations are associated with the observed densities of eggs. The issue of the number of manageable stocks cannot be solved simply by describing how many spawning events are occurring.

The understanding of the "pelagic-juvenile" stage is limited, despite its obvious importance. Details of transport mechanisms providing progeny of SAB reproduction to nurseries in the MAB need to be better understood. Increased sampling of the neuston, or near-surface, layers of the ocean between production areas and estuarine nursery areas, associated with appropriate oceanographic observations, would provide much-needed background into factors affecting this transport and estuarine recruitment.

It is also apparent that there has been a tight correlation between the population size and the contribution of the spring-spawned cohort to fall trawl collections in the last three decades. Yet our knowledge of reproduction in the SAB is limited to a brief, undersampled period in the 1970's, when the population was at a relatively low ebb. Furthermore, larvae produced in June in the southern part of the MAB appear not to survive (unless recruits to Maine estuaries result from this output; Creaser and Perkins 1994), the fate of the remaining MAB summer offspring remains enigmatic, and the relative contribution of this summer-spawned cohort to year-class success would seem to be negligible.

There is some evidence of a spawning event during the fall in the Cape Kennedy region of Florida, which appears to be discrete, rather than a continuation of spawning in the MAB. This evidence has been demonstrated in Fahay (1998) with larval occurrences and a disjunct autumn distribution of fishes between 26 and 40 cm, while other studies have presented gonosomatic data to suggest the same thing (Hare and Cowen 1993). Admittedly, some of this evidence is weak and based on incomplete sampling, and this should be improved in order to determine the origin of these spawning fish, the magnitude of spawning, and the fate of any progeny.

The third list comes from the Atlantic States Marine Fisheries Commission, which listed the following prioritized research needs for bluefish (Kline 1997):

1. Size and age composition of the fisheries by gear type and statistical area should be collected;

2. Commercial and recreational landings of bluefish should be targeted for biological data collection where ever possible;

3. Explore alternative methods for assessing bluefish, such as length-based and modified DeLury models;

4. Measures of CPUE under different assumptions of effective effort should be evaluated to allow evaluation of sensitivity of results;

5. Conduct research to determine the timing of sexual maturity and fecundity of bluefish;

6. Scientific investigations should be conducted on bluefish to develop an understanding of the long-term, synergistic effects of combinations of environmental variables on various biological and sociological parameters such as reproductive capability, genetic changes, and suitability for human consumption;

7. Conduct research on oceanographic influences on bluefish recruitment;

8. Initiate research on species interactions and predator/prey relationships; and

9. Studies on the interactive effects of pH, contaminants, and other environmental variables on survival of bluefish.

Finally, the fourth list comes from Auster and Langton (1998). A number of areas where primary data are lacking, which would allow better monitoring and improved experimentation, ultimately leading to improved predictive capabilities, are:

1. The spatial extent of fishing induced disturbance. While many observer programs collect data at the scale of single tows or sets, the fisheries reporting systems often lack this level of spatial resolution. The available data makes it difficult to make observations, along a gradient of fishing effort, in order to assess the effects of fishing effort on habitat, community, and ecosystem level processes.

2: The effects of specific gear types, along a gradient of effort, on specific habitat types. These data are the first order needs to allow an assessment of how much effort produces a measurable level of change in structural habitat components and the associated communities. Second order data should assess the effects of fishing disturbance in a gradient of type 1 and type 2 disturbance treatments.

3. The role of seafloor habitats on the population dynamics of harvested demersal species. While there is often good time series data on late-juvenile and adult populations, and larval abundance, there is a general lack of empirical information (except in coral reef, kelp bed, and for seagrass fishes) on linkages between EFH and survival, which would allow modeling and experimentation to predict outcomes of various levels of disturbance.

These data, and any resulting studies, should allow managers to regulate where, when, and how much fishing will be sustainable in regards to EFH. Conservation engineering should also play a large role in developing fishing gears which are both economical to operate and minimize impacts to environmental support functions.

2.2.8 Review and Revision of EFH Components of FMP

Section 600.815 (a)(11) states that Councils and NMFS should periodically review the EFH components of FMPs, including an update of the fishing equipment assessment. Each EFH FMP amendment should include a provision requiring review and update of EFH information and preparation of a revised FMP amendment if new information becomes available.

The Council will amend its FMPs at least every five years as called for in this section, and is also including a habitat framework adjustment provision that can be included in each FMP. Due to the very strict time constraints of meeting the October-MSFMCA deadline mandated by Congress (with very limited additional funds), it was impossible to include much of the state survey data that will be available in the future, as well as much of the unpublished literature on contaminants etc. It is important to understand that this EFH is a "work in progress" and that the process will evolve. This framework provision is envisioned to work along the existing framework provisions established for the New England Multispecies FMP by the NEFMC. A similar process is proposed in this FMP for other non-EFH management measures.

The FMP contains descriptions and identification of essential fish habitat, estimates of gear impacts on essential fish habitat, and recommendations that describe options to avoid, minimize, or compensate for the adverse effects and promote the conservation and enhancement of EFH. In some cases, definitions, estimates, and recommendations are made in general terms because specific content and concentrations of organic and inorganic compounds have not yet been compiled and/or specified by regulatory agencies. The purpose of this framework provision is to incorporate such specifics into the definitions, estimates, and recommendations as specifics are developed via existing data not available when the FMP was adopted. The framework provision is not to be used to add or delete the conservation and enhancement recommendations, but only to adjust description and identification of EFH (boundaries), identification of HAPC, and revise gear management measures (such as degradable panels and lines).

The Council envisions creating a Habitat Monitoring Committee (HMC) made up of at least staff representatives from the NMFS Northeast Fisheries Science Center, the Northeast Regional Office Management and Habitat Sections, the Atlantic States Marine Fisheries Commission, and Chaired by the Council Executive Director or his/her designee. The HMC will meet at the call of the HMC Chair, to develop options for MAFMC consideration on any adjustment or elaboration of any FMP

EFH definition or gear impacts of EFH recommendations necessary to achieve the habitat goals and objectives. Based on this review, the HMC will recommend specific measures to revise EFH definitions, revise gear specifications.

The MAFMC, through its Habitat Committee, will review the recommendations of the HMC and all of the options developed by the HMC and other relevant information, consider public comment, and develop a recommendation to meet the FMP's habitat goals and objectives. If the MAFMC does not submit a recommendation that meets the FMP's habitat goals and objectives and is consistent with other applicable law, the Regional Administrator may adopt by regulatory change any option developed by the HMC, unless rejected by the MAFMC or tabled by the MAFMC for additional consideration, provided the option meets the FMP's habitat goals and objective and is consistent with other applicable law. The frameworked process for developing EFH and/or gear impacts will follow the same overall process as that for other non-EFH management measures.

2.3 DESCRIPTION OF FISHING ACTIVITIES

2.3.1 History of Landings

2.3.1.1 Commercial fishery

Bluefish have been commercially harvested in the U.S. for centuries. Bigelow and Schroeder (1953) concluded bluefish were plentiful at the time that New England was first settled based on the accounts by an author in 1672. However, the abundance of bluefish in southern New England waters has fluctuated periodically since then. An interesting recent account describes the "mosquito fleet" which operated out of Charleston, South Carolina, throughout the nineteenth and first half of the twentieth century (Bishop *et al.* 1994). This fleet of vessels 20 to 35 feet in length sailed daily from Charleston, out of sight of land with no navigational aids, and provided fresh bluefish, among other species, to the residents, a feat which won the respect and admiration of the community.

In more recent times, total coastwide bluefish landings (commercial and recreational) have averaged 86 million lbs (1981-1989), with commercial landings comprising roughly 17% of the total landings during that time (Table 23). Since 1981, commercial landings have averaged about 13 million lbs. However, commercial landings declined 44% from a peak of 16.5 million lbs in 1981 to only 9.3 million lbs in 1996.

Bluefish are pursued in both state and EEZ waters by a variety of commercial gears (Table 24). Coastwide (1987-1996 combined) most bluefish (48%) were landed by gill nets (all types combined) followed by otter trawls (19%). Fish pound nets accounted for 7% of the commercial catch followed by hand and troll lines (6%) and haul seines (3%) during the same time period.

During the period 1976-1987, beach haul seines harvested a significant portion of bluefish in New York and South Carolina. The quantities of bluefish harvested by this gear during 1987-1996 declined considerably relative to earlier years, with measurable landings only in New York, Maryland, Virginia, and North Carolina (Table 25). The states of Maryland and South Carolina had more bluefish landed commercially by hand lines from 1987 to 1996 than any other gear type (Table 25). Fish otter trawls were predominant in Rhode Island, Connecticut, and New York (Table 25). Some type of gill net caught significant amounts of bluefish in all states except Connecticut, South Carolina, Georgia and Florida. Almost all of the bluefish in Maine and New Hampshire were caught by gill nets and this gear type was also predominant in Delaware waters. Runaround gill nets were predominant in New Jersey.

Commercial landings data for specific gear types over time are presented in Table 26. Since 1985, gill nets (all types combined) and otter trawls have been the predominant gear types while the other major gear types (haul seines, paired trawls, purse seines, pound nets, troll and hand lines) has remained relatively consistent at low levels or have declined in importance (Table 26).

A total of 61% of the 1994 commercial landings came from state waters (Table 27). Due to a change in the reporting system, commercial landings by area are not available for 1995 and 1996. Coastwide from 1985 to 1994, an average of 63% of bluefish harvested commercially were caught in water areas under state jurisdiction. In recent years (1992 and 1993 for example), commercial landings from the EEZ are similar to those taken in state waters (Table 27).

By subregion (1985-1994), most bluefish were caught commercially in waters under state jurisdiction except in the New England subregion where EEZ landings were predominant (Table 28). State waters dominated in every year for the Mid-Atlantic region and every year except 1994 for the South Atlantic (Table 28). In 1994, 70% of landings were in state waters in New England, 69% in the Mid-Atlantic region, and 42% in the South Atlantic. In New England, the decreasing trend in the amount of bluefish caught in state waters since 1986 with a concomitant increase in the proportion of the catch from EEZ waters continued, with the exception of 1994 when landings in state waters were twice those of the EEZ (Table 28). Commercial landings in the Mid-Atlantic subregion exceeded landings in the other two subregions each year from 1985 to 1994, except 1987, 1989, and 1990, when South Atlantic landings were predominant, and in 1991, when the Mid- and South Atlantic each had 39% of coastwide commercial landings (Table 28).

From 1976 to 1978, more bluefish were harvested in Virginia waters than any other state while North Carolina predominated from 1979 to 1987 (MAFMC 1990a). Since 1985, North Carolina had the highest commercial landings in every year except 1994, when New Jersey was slightly higher (Table 29). The states with the highest average annual percent commercial landings for the 1985-1996 period were North Carolina (29.3%), New Jersey (17.2%), New York (12.3%), Rhode Island (9.4%), Virginia (8.4%), Florida (8.4%), and Massachusetts (7.8%). These seven states combined produced 93% of the annual landings.

Seasonally, most bluefish were harvested commercially from May through October (Table 30). Average monthly landings for the period 1987-1996 peaked at 1.2 million lbs in October. Most bluefish were caught during the fall months from September through November.

2.3.1.2 Recreational fishery

Saltwater angling surveys were conducted for the entire Atlantic coast in 1960 (Clark 1962) and 1965 (Deuel and Clark 1968) by the U.S. Fish and Wildlife Service and in 1970 (Deuel 1973) by the National Marine Fisheries Service. Beginning in 1979 and continuing to present, the NMFS has conducted annual Marine Recreational Fishing Statistical Surveys (MRFSS). This survey is designed to expand interview data on catch and angler effort from both on site creel census and telephone surveys to state and regional levels. The MRFSS distinguishes between fish available for identification and measurement by the interviewers (Type A), fish used as bait, filleted, or discarded dead (Type B1), and fish released alive (Type B2). The sum of types A, B1, and B2 comprise the total recreational catch whereas types A and B1 constitute total recreational landings. Subsequent to the publication of the previous plan (MAFMC 1990a) the MRFSS data were adjusted to make the data more accurate. As a result, the numbers in the current plan do not correspond to those in the previous plan.

Bluefish are very important in the Atlantic coast recreational fishery. Wilk (1980) noted that no other species on the Atlantic coast is as abundant throughout such a wide range and variety of habitats as bluefish. MRFSS data indicate that since 1981 recreational bluefish landings averaged 50 million lbs, ranging from 95 million lbs in 1981 to 14 million lbs in 1995. In 1996, bluefish recreational landings were approximately 15 million lbs (Table 23). In 1987, bluefish were the fish most sought by marine anglers in the North Atlantic, second only to summer flounder in the Mid-Atlantic, and fourth in preference for anglers in the South Atlantic (MAFMC 1990a). During 1987, bluefish comprised 34% by weight of all species caught by recreational fishermen along the Atlantic coast (MAFMC 1990a). The 1979 to 1987 recreational catch represented a substantial increase over the 1960 to 1970 recreational harvest when bluefish averaged approximately 10% of all species caught by marine anglers along the Atlantic coast. Bluefish were the predominant species (by number) harvested by anglers in 1987.

After reaching a secondary peak in 1986, recreational bluefish landings began to decline. The decline in bluefish recreational catch and landings continued over the last decade (Table 31). MRFSS data indicate that anglers caught an estimated total of 27.6 million bluefish in 1987, with the numbers declining to a low of 9.9 million in 1993. Numbers increased to approximately 12 million in 1994, but then decreased to 10.5 million in 1995 and, in 1996, decreased again to a low of 9.9 million (Table 31). The weight of bluefish landed by anglers declined from about 77 million lbs in 1987 to just less than 15 million lbs in 1996 (Table 32). The average weight of the bluefish landed has fluctuated during the years 1987 through 1996 between a low of 2.7 pounds (1994) and a high of 4.9 pounds (1988). The percent of the catch released by anglers has continued to increase from the 24 % reported for 1987 to 54 % in 1996 (Table 31).

An analysis of the recreational landings by subregion indicates more bluefish by weight were landed in the Mid-Atlantic than in the North and South Atlantic every year from 1987 to 1996, except for 1993 and 1994 when North Atlantic landings were highest (Table 32). In most years, and on average, the weight of the Mid-Atlantic landings (average 55.7%) exceeded those from the North Atlantic (average 33.1%) and South Atlantic (average 11.2%) regions (Table 32).

For the period 1987-1996, the percent of total weight of bluefish landed from state waters usually exceeded the weight landed from the EEZ (Table 33). In the North Atlantic, weight of landings from state waters has averaged about three times EEZ landings. In the Mid-Atlantic, state landings by weight averaged twice that of the EEZ, and in the South Atlantic, weight landed from state waters averaged seven times the EEZ weight.

As in previous years, private/rental boats remained the principal mode of catch and landings for bluefish during 1987-1996, catching 51% by number and 59% by weight (Table 34). The party/charter boat mode accounted for 13% of the catch in number and 26% by weight during the same period.

Anglers in New Jersey harvested the highest percentage of all bluefish caught by recreational fishermen along the Atlantic coast, landing 21.9% of the total weight of bluefish caught by Atlantic coast anglers for the period 1987-1996 (Table 35). Other states in which recreational fishermen caught more than 10% of the total coastwide harvest of bluefish by weight included Massachusetts, Connecticut, and New York.

2.3.1.3 Foreign fishing activities

The amount of bluefish taken by foreign fishing vessels has varied from a low of 40,300 lbs in 1985 to a high of 170,500 lbs in 1982 (MAFMC 1990a). Bluefish is a prohibited species for harvest by foreign vessels. As a result, the foreign catch of bluefish was incidental to other directed fisheries. Monthly catch data for 1985 indicated most bluefish were caught by foreign vessels fishing for squid in late fall and squid and mackerel in winter (MAFMC 1990a). However, by 1990 foreign fishing for squid and butterfish was eliminated along the U.S. Atlantic coast. As a result, there has been no foreign catch of bluefish since 1990.

2.3.2 Economic Characteristics of the Fishery

2.3.2.1 Commercial fishery

Commercial landings of bluefish decreased 44% from 16.5 million lbs in 1981 to 9.3 million lbs in 1996 (Table 23). Commercial landings in 1996 were 18% above the 1995 level and 27% below the 1981-1996 mean. On average (1985-1994), the exvessel value of bluefish commercial landings from state waters were about twice those from EEZ waters (Table 36). From 1985-1996, the exvessel value of bluefish commercial landings ranged from $2.2 million in 1989 to $3.2 million in 1987 and 1990 (Table 37). In 1996, the value of bluefish landings was $2.8 million, which represented less than a 2% decrease from 1995 and slight increase relative to the 1985-1996 average. Average exvessel price of bluefish (1996 adjusted dollars) varied from $0.13 to $0.35 per pound for the period 1985-1996. Exvessel price was highest in 1995 at $0.35 per pound. In 1996, bluefish exvessel price per pound was $0.30 coastwide (Table 37). The coastwide average exvessel bluefish price per pound for the period 1985 through 1994 varied by month with the lowest prices received in the fall (Table 38). Prices paid for bluefish landed from state waters were the same as those paid for bluefish in the EEZ (Table 38). Due to a change in the reporting system, commercial landings by area are not available for 1995 and 1996. Price fluctuations are associated with supply responses, with higher prices generally corresponding to significant decreases in landings. A supply/price relationship is evident on a monthly basis.

Bluefish comprised 0.09% of the total value of all finfish and shellfish species landed along the Atlantic coast of the U.S. in 1996. Bluefish exvessel value was estimated at $3.2 million in 1996, with North Carolina recording the highest value of bluefish landings by state at $1.2 million. However, this represented only 1.1% of the total value of all species of fish and shellfish landed in commercially in North Carolina. South Carolina had the lowest landing value at $1,000. This represented only 0.004% of the value of all South Carolina commercial landings of all finfish and shellfish. Relative to total landings by state, bluefish were most important in North Carolina, contributing with the largest percentage of exvessel value of all commercial landings in that state.

The economic impact of the commercial bluefish fishery relative to employment and wages is difficult to determine given the nature of the fishery (most bluefish are landed as incidental catch). However, it can be assumed that only a small amount of the region's fishing vessel employment, wages, and sales is dependent on bluefish since bluefish represents only 0.10% of the total landings (by weight) and 0.09% of the total value of all finfish and shellfish on the Atlantic coast.

2.3.2.2 Recreational fishery

MRFSS catch data by mode indicates that 51% of bluefish were caught by private and rental boats during the period 1987-1996 (Table 34). Private vessels range in size and value from small inshore skiffs to large offshore yachts. It is not possible to determine the percentage of each type of vessel used for bluefish fishing or the cost expenditures by sub-class of vessel. It is probable that most of the private vessels used are larger than skiffs and therefore involve sizable expenditures for procurement and maintenance, thus contributing greatly to measures of economic impact. However, it is likely that private vessels are also used to fish for species other than bluefish and for several non-fishing purposes. Therefore, any expenditure and/or cost data attributed to bluefish fishing would have to be prorated to account for this multi-purpose use.

In addition to private and rental boats, 36% of bluefish were caught from shore and 13% from party and charter boats (Table 34) during the 1987-1996 period. Party and charter vessels carrying passengers for hire fish for bluefish within the U.S. EEZ are not required to have a federal permit at the present time. Without individual logbooks, the total number of party and charter vessels actually directing trips on bluefish is difficult to determine. In 1985, a total of 528 party and 1997 charter boats operated out of Atlantic coast ports from Maine through Florida (SFI 1988). These vessels generated a yearly revenue of $160 million. However, documentation of the demand for bluefish fishing on party and charter boats and cost breakdowns per trip for specific regions along the coast are lacking. In 1994, a total of 545 party and about 1,950 charter boats operated out of ports along the Atlantic seaboard (ASMFC 1994).

Because of the importance of bluefish to recreational anglers, a short-term decline in expenditures by these anglers as a result of bluefish management measures would impact the sales, service, and manufacturing sectors of the recreational fishing industry. In 1985, Atlantic coast direct sales related to recreational fishing amounted to $2.6 billion (SFI 1988). These sales and services required 42 thousand person years of labor and generated wages of $522 million (SFI 1988).

The report prepared by SFI (1988) also included estimates of the economic activity specifically associated with bluefish. The estimates dissaggregated the regional economic impacts of bluefish based on the percent of total trips where bluefish were reported as the target species. The minimum estimate uses the target percent as given. The maximum estimate assumes that those individuals who did not identify a target species have the same distribution of species preferences as those who did express a preference. The resultant ranges of estimates of the economic activity associated with the 1985 recreational bluefish fishery on the Atlantic coast are: retail sales -- $390.7 to $574.1 million; person years of employment -- 6,412 to 9,445; and wages and salaries -- $79.7 to $117.0 million (SFI 1988). Since that period, bluefish landings have generally declined, reflecting a drop in availability, abundance, and/or anglers interest. As such, it is likely that fishery expenditures, employment, wages, and salaries associated with the bluefish recreational sector have decreased in recent years.

The total value recreational anglers place on the opportunity to fish can be divided into actual expenditures and a non-monetary benefit associated with satisfaction. In other words, anglers incur expenses to fish (purchases of gear, bait, boats, fuel, etc.), but do not pay for the fish they catch or retain nor for the enjoyment of many other attributes of the fishing experience (socializing with friends, being out on the water, etc.). Despite the obvious value of these fish and other attributes of the experience to anglers, no direct expenditures are made for them, hence the term "non-monetary" benefits. In order to determine the magnitude of non-monetary benefits, a demand curve for recreational fishing must be estimated. In the case of bluefish, as with many recreationally sought species, a demand curve is not available. Part of the problem in estimating a demand curve is due to the many and diverse attributes of a recreational fishing experience: socializing, weather, ease of access and site development, catch rates, congestion, travel expenditures, and costs of equipment and supplies, among others. A recreational angler's willingness-to-pay for bluefish must be separated from the willingness-to-pay for other attributes of the experience. Holding all other factors constant (expenditures, weather, etc.), a decrease in the catch (or retention rate) of bluefish would decrease demand and an increase in the catch (or retention rate) should increase demand. Each change will have an associated decrease/increase in expenditures and non-monetary benefits.

Although a recreational demand curve for bluefish is unavailable, some studies have estimated the value of a recreational fishing day. Rockland (1983) presented value per trip for marine recreational fishing at nine sites in Delaware. This study used the Travel Cost Method with a variety of estimation approaches. The range of average values for the boat fishing sites was $20.58 to $39.90 per day, whereas the range for shore fishing was $37.47 to $62.53 per day. A study of recreational striped bass fishing on the Atlantic coast presented estimates of $39 to $169 per day (Norton *et al.* 1983). A 1982 study conducted for the state of Florida derived estimates of $18.97 to $57.99 per day for all marine species (Bell *et al.* 1982).

A more recent study by Strand *et al.* (1991) also estimated average total cost for day trips by mode, for selected states along the Atlantic coast (Table 39). Included in the estimates were costs for travel and services, where services could include costs for bait, tackle, cleaning, fuel, pier fees, and boat fees. Fishing from the beach was the least costly, ranging in price from $13.77 per day in New York to $44.44 per day in Delaware. Charters and rentals were the most expensive, ranging in price from $52.25 per day for a rental in Maryland to $237.03 per day for a rental in North Carolina (Table 39).

MRFSS estimates indicated that 976,432 shore-based and 1,428,308 boat-based trips targeted bluefish in 1996. An estimate of total expenditures made to go fishing for bluefish can be calculated by multiplying the number of trips by an estimate of average cost per day, but it is not possible to estimate the total non-monetary benefit without more sophisticated statistical techniques which allow estimation of the marginal value per trip.

It is important to note that the average cost of a bluefish trip or fishing day is not equivalent to the marginal value of a recreationally caught bluefish. The distinction is sometimes overlooked when estimating economic impacts. Attributes of a recreational fishing day other than catching fish are valued by anglers, so all expenditures are not dependent on bluefish catch. The marginal value of bluefish catch must be estimated, and as with any normal good, marginal value declines with increasing quantity. Agnello (1989) determined the marginal value of recreationally caught bluefish by considering fishing success as a shift factor in the demand for bluefish trips. Using the travel cost method, estimates of marginal value for the first bluefish kept by the average angler ranged from $1.82 to $5.71 (1987 dollars) depending on the specification of the regression model. Estimates for the average bluefish, about four fish per angler, ranged from $.43 to $1.36, indicating a declining marginal value for each successive bluefish kept.

Clearly, the economic impacts associated with Atlantic coast recreational fishing for bluefish are significant. However, estimates of aggregate economic value are not currently available. Addressing the economic value associated with marine recreational fishing when developing fishery management plans is important. Ideally, the value that anglers are willing to pay for the recreational opportunity that they enjoy should be considered when evaluating plans that affect both the recreational and commercial fisheries. Recreational fishing contributes to the general well being of participants by affording them opportunities for relaxation, experiencing nature, and socializing with friends. The potential to catch and ultimately consume fish is an integral part of the recreational experience, though studies have shown that non-catch related aspects of the experience are often as highly regarded by anglers as the number and size of fish caught. Since equipment purchase and travel related expenditures by marine recreational anglers have a positive effect on local economies, the maintenance of healthy fish stocks is important to fishery managers.

2.3.2.2.1 1990 survey of charter and party boats

The charter and party boat industry is important in several states in the management unit of this FMP. On average for the 1987-1996 period, 13% of the bluefish (in numbers) landed by anglers off the Atlantic coast were caught from party or charter boats (Table 34).

To provide additional information on this segment of the industry, the Council conducted a survey of charter and party boat owners in the summer of 1990 with the purpose of acquiring information in support of management efforts for the summer flounder, scup, and black sea bass fisheries. This survey also provided useful information for a number of other species including bluefish. A mailing list was compiled from the NMFS vessel permit files, including all vessels which indicated they were involved in party and charter activities (permit Category 2). The list included 402 vessels.

However, it is important to notice that since this survey was conducted, bluefish landings have generally declined, reflecting a drop in availability, abundance, and/or anglers interest. As such, some of the results obtained from this survey may not accurately describe current fishing trends (e.g., interest and demand for bluefish, desirability of bluefish, etc.).

Consultation with Council members yielded concerns that a number of vessels did not hold federal permits, and would not be included in the survey. Representatives from New Jersey, New York, and Virginia supplied the Council with lists supplementing the NMFS permit files, and an additional 190 questionnaires were mailed.

A total of 592 surveys were sent out to 13 east coast states (Table 40). Massachusetts, New Jersey, New York, and Virginia were most heavily represented, accounting for 80% of survey mailings.

A total of 172 of the 202 surveys returned to the Council were usable. The 30 returns which could not be used were inappropriate mailings that fell into the following general categories: did not charter/fish in 1989; private boat, not for hire; dive boat, primarily after lobsters; returned as undeliverable by Post Office; or sold boat. Usable returns equaled 29% of total mailings, with the percentage ranging from approximately 20% - 50% for individual states.

Some of the analyses conducted on the survey divided the responses into "Party boat" versus "Charter boat" categories. Typically, charter vessels are thought of as hiring out for a day's fishing to a small number of individuals at a cost of over $100 per person. They provide a high level of personal attention to the passengers and will make special efforts to find the particular species of interest to their clients.

"Party boats" are generally larger vessels which run on a fixed schedule and carry from 10 to 100 passengers, averaging around 20. They offer fewer options and less attention to passengers, yet charge much lower fares than charter boats (in the $20 - $40 range).

In order to have the ability to differentiate between these two groups, the data were partitioned based on the reported number of passengers each vessel could carry. Examination of the data showed a logical division between those vessels which reported carrying 8 or fewer passengers and those able to carry more than 8. The average fee charged per person dropped significantly for those vessels carrying more than 8 passengers. For purposes of this analysis then, "charter boats" are defined as those boats carrying 8 or fewer passengers, and "party boats" are those which may carry 9 and above. It is recognized that charter boats are generally licensed for six passengers and, in fact, responses to another question indicated that the average charter boat carried 6 passengers (SD = 0.4), while the average party boat carried 53 (SD = 32), so it is quite likely that the respondents which indicated they owned a charter boat that carried eight people were including the captain and mate whereas in the subsequent question they were referring to the six paying passengers.

The first question on the survey attempted to gauge the interest or demand which party and charter boat customers exhibited for common species (or species groups). Given a five point scale, owners were asked to rank each species as being: 1 = Low, 2 = Somewhat Low, 3 = Moderate, 4 = Somewhat High, or 5 = High in interest to their customers. Calculating mean values of responses allows comparison of the different species using a single number for each.

Spot ranked as the most desirable fish for party boats (mean interest = 4.7), illustrating its importance to the well-represented boats of Virginia (Table 41). It was followed by bluefish (4.6), then summer flounder (3.6), Atlantic Mackerel (3.5), and striped bass (3.5). The top four fish which party boats reported catching were: bluefish (4.0), Atlantic mackerel (3.5), spot (3.4), and black sea bass (2.9).

Charter boat owners reported a preference ordering similar to that of party boats for their customers, with the exception that large pelagics took the second ranked spot along with bluefish (Table 41). The top five species were: spot (4.6), large pelagics (3.9), bluefish (3.9), striped bass (3.7), and summer flounder (3.2).

In 1989, the average party boat customer traveled 67 miles, with a standard deviation (SD) of 43 miles. The farthest party boat customer traveled 695 miles (SD = 1,125 mi.). In 1989, the average charter boat customer traveled 123 miles (SD = 194 mi.). The farthest charter boat customer traveled 727 miles (SD = 914 mi.).

Charter boat respondents indicated that 38% of their customers were more interested in a particular species, 15% were more interested in fishing enjoyment, and 46% were about equally interested in each. For party boats, the responses were 43% for a particular species, 12% for the fishing experience, and 45% equally for each.

For charter boats, 89% of the respondents were both owner and operator (7% just owner, 5% just captain). The party boat responses were 94% owner and captain, 2% just owner, and 4% just captain. Only 14% of the charter boats were used year round (86% seasonally), while 18% of the party boats were used year round (82% seasonally). The average charter boat carried 6 passengers (SD = 0.4), while the average party boat carried 53 (SD = 32).

Thirty six percent of the charter boat respondents indicated that they fished commercially in 1989, with 91% of those fishing commercially from the charter boat and 9% from another boat. For party boats, 26% of the respondents indicated they had fished commercially in 1989, with 69% of those fishing commercially from the party boat and 31% from another boat.

On a scale of 1 (almost none) to 5 (almost all), respondents were asked what part of their personal earnings in 1989 came from party and charter boat fishing, commercial fishing, or other sources. For charter boat respondents, the mean answers were: charter or party boat fishing, 2.2; commercial fishing, 1.5; and other sources, 4.0. For party boat respondents, the mean answers were: charter or party boat fishing, 3.2; commercial fishing 1.3; and other sources, 2.4.

Respondents were also asked what their perception of fishing success was for 1989 and what they thought their customers' perceptions of 1989 fishing success was. Ranking was on a scale of 1 (good) through 3 (bad). For charter boats, the operators reported a mean of 2.1 (SD = 0.7) for their own view and 1.9 (SD = 0.7) for their customers. For party boat operators, their own perception was 2.2 (SD = 0.6), while they thought their customers would rate the season at 2.0 (SD = 0.6).

The survey included a series of questions to determine how the respondents felt business was in 1989 compared to 1985. Both charter and party boats made slightly fewer trips in 1989 compared to 1985 (Table 42). The days per trip and/or trips per day were essentially unchanged. They operated fewer days per week, on average, and carried slightly fewer customers. The average price per trip increased from $121.80 to $149.50 for charter boats and $26.20 to $29.20 for party boats. The average number of fish taken per customer fell from 10.9 to 8.3 for charter boats and from 15.2 to 9.9 for party boats between 1985 and 1989. The number of crew members stayed relatively constant. The average cost per trip rose from $96.10 to $131.10 for charter boats and from $113.30 to $146.60 for party boats during the period.

2.3.2.2.2 Marine recreational descriptive statistics

In 1994, sportfishing surveys were conducted by NMFS in the Northeast Region (Maine to Virginia) to obtain demographic and economic information on marine recreational fishing participants from Maine to Virginia. Data from the surveys were then used to access socio-economic characteristics of these participants, as well as to identify their marine recreational fishing preferences and their perceptions of current and prospective fishery management regulations. This information will be used in future stages of the research to estimate statistical models of the demand for marine recreational fishing for eight important recreational species. The information that follows is excerpted and paraphrased from a preliminary report by Steinback and O'Neil (MS In prep.).

"Marine recreational fishing is one of the most popular outdoor recreational activities in America. In 1992, the lowest level of participation during the last ten years, approximately 2.57 million residents of coastal states in the Northeast Region participated in marine recreational fishing in their own state. Participation increased approximately 5% in 1993 (2.7 million) and increased another 14% in 1994 (3.1 million), exceeding the ten-year average of 2.9 million. Although the total number of finfish caught in the Northeast Region has declined over the past ten years effort (trips) has remained relatively stable. An estimated 22.4 million fishing trips were taken in 1994, up from 19.3 million in 1993."

The following discussion contains demographic and socio-economic characteristics of anglers, as well as their preferences, attitudes, and opinions, toward recreational fishing activities and regulations. There was little or no difference in mean age across subregions. "The largest proportion of anglers in both subregions were 36-45 years old (NE=28%, MA=25%). However, comparatively, New England anglers were younger than Mid-Atlantic anglers. Results show that participation in marine recreational fishing increased with age, peaked between ages of 36 to 45, and subsequently declined thereafter. The resultant age distribution is similar to the findings of other marine recreational studies. However, the distribution is not reflective of the general population in these subregions. Bureau of the Census estimates indicate population peaks between the ages of 25 to 34 in both subregions, declines until the age of 64 and then increases substantially." The complete distribution of recreational anglers by age for both subregions is as follows: between the ages of 16-25, 8% in NE and 7% in MA; between 26-35, 24% in NE and 20% in MA; between 36-45, 28% in NE and 25% in MA; between 56-65, 12% in NE and 15% in MA; and 65 and over, 8% in NE and 11% in MA. In this survey, anglers under the age of 16 were not interviewed and are not included in the analysis.

In both subregions, at least 88% of the anglers (age 25 and over) had obtained at least a high school degree (NE=91%, MA=88%). "While the educational background is similar across subregions, a greater portion of the anglers in New England earned college or post graduate/professional degrees (NE=29%, MA=23%). The shape of the educational distribution essentially mirrored the general population in both subregions. However, the average number of anglers without a high school degree was considerably lower than Bureau of the Census estimates (age 25 and over) for the general population. On the other hand, it appears that anglers in New England and the Mid-Atlantic earned less post graduate/professional degrees than Bureau of Census estimates."

When anglers were asked to describe their racial or ethnic origin, almost all of the anglers interviewed in both subregions considered themselves to be white (NE=95%, MA=90%). "In the Mid-Atlantic, most of the remaining individuals were black (7%), leaving 3% to be of other ethnic origins. In New England, the remaining anglers were evenly distributed across other ethnic origins. The high occurrence of white fishermen is representative of the general population of the coastal states in New England. Approximately 94% of the population in 1993 was estimated to be white. However, in the Mid-Atlantic, the percentage of white anglers was considerable higher than Bureau of Census populations estimates, and the percentage of black fishermen was 12 % lower."

When anglers were asked to indicate from a range of categories what their total annual household income was, only minor differences between subregions were found. "The largest percentage of household incomes fell between $30,001 and $45,000 for both subregions (NE=27%, MA=26%). In comparison to the general population, anglers' annual household incomes are relatively higher in both subregions. Results are consistent with previous studies which showed that angler household incomes are generally higher than the population estimates."

If it is assumed that "years fished" is a proxy for "experience," the survey data shows that anglers in New England are relatively less experienced than anglers in the Mid-Atlantic. The distribution of recreational anglers years of experience is as follows: 0-5 years of experience, 22% in NE and 16% in MA; 6-10 years of experience, 10% in NE and 10% in MA; 11-15 years of experience, 13% in NE and 14% in MA; 16-20 years of experience, 9% in NE and 9% in MA; 21-25 years of experience, 12% in NE and 12% in MA; 26-30 years of experience, 13% in NE and 12% in MA; and 30 or more years of experience, 21% NE and 26% in MA.

On average, it was found that New England anglers spent more on boat fees, lodging, and travel expenses than Mid-Atlantic anglers (due to budget and interview time constraints, expenditure information pertaining to bait, tackle, ice, or meals was not collected). "During the follow-up telephone portion of the survey, anglers that fished from a party/charter boat or a private/rental boat were asked how much they personally spent on boat fees for the trip in which they were interviewed. Boat fees averaged $61.00 per trip in New England and $51.00 in the Mid-Atlantic. Two categories of lodging expenses were obtained. The first category (Lodging (>0)) is an estimate of the mean lodging expense per night for those anglers who indicated they spent at least one night away from their residence and personally incurred lodging costs. Subsequently, the second category (Lodging (all)) is an estimate of mean lodging expenses across all overnight anglers, regardless of whether an angler incurred a lodging expense. Per night costs were estimated by dividing total lodging costs for the trip by the number of days the angler was away from his/her residence on the trip. Anglers that personally incurred lodging expenses spent $58.00 on average per night in New England and $47.00 per night in the Mid-Atlantic. Across all overnight anglers, per night lodging expenses in New England averaged $29.00 and in the Mid-Atlantic, $21.00. Anglers expenditures also included money spent on gas, travel fares, tolls, and ferry and parking fees. One-way travel expenditures averaged $11.00 in new England and $8.00 in the Mid-Atlantic per trip. Therefore, if arrival costs are tantamount to departure costs, average round-trip travel expenses would approximate $22.00 in New England and $16.00 in the Mid-Atlantic." Since certain expenditures such as parking, tolls, and other travel fares may be incurred only once, the estimated round-trip travel expense should be considered an upper bound estimate.

Survey results show that over 50% of the anglers in both subregions indicated boat ownership (NE=51%, MA=53%). These results were obtained when anglers were asked if anyone living in their household owns a boat that is used for recreational saltwater fishing.

Regarding the duration of the interviewed trip length, "at least 80 % of the anglers in both subregions indicated they were on a one-day fishing trip (NE=80%, MA=84%). One-day fishing trips were defined to be trips in which an angler departs and returns on the same day. Less than one fourth of the respondents indicated the day fishing was part of a longer trip which they spent at least one night away from their residence (NE=20%, MA=16%)."

"Respondents were asked why they chose to fish at the site they were interviewed. "Convenience" and "better catch rates" were the main reasons why anglers chose fishing sites in both subregions. Forty-nine percent of the anglers in New England and 57 % of the anglers in the Mid-Atlantic indicated "convenience" as either first or second reason for site choice. "Better catch rates" was the first or second stated reason for site choice by 51 % of the anglers in New England and 50 % of the anglers in the Mid-Atlantic. Other notable responses were "always go there," "boat ramp," "access to pier," and "scenic beauty." Results indicate that although anglers chose fishing sites for many different reasons, sites that offered good catch rates and were convenient attracted the most anglers."

Recreational anglers were asked to rate recreational fishing against their other outdoor activities during the last two months. Specifically, they were asked if fishing was their most important outdoor activity, their second most important outdoor activity, or only one of many outdoor activities. "Over 60% of the respondents in both subregions (NE=61%, MA=68%) reported marine recreational fishing was their most important outdoor activity during the past two months. Less than 30 % in both subregions (NE=27%, MA=20%) said recreational fishing was only one of many outdoor activities. These results were consistent with national outdoor recreation surveys carried over the past three decades indicating that fishing is consistently one of the top outdoor recreational activities in terms of number of people who participate.

Recreational anglers ratings of reasons (7 preestablished reasons for fishing) for marine fishing are presented in Table 43. More than 66% of the anglers in both subregions said that it was very important to go marine fishing because it allowed them to: spend quality time with friends and family (NE=81%, MA=85%); enjoy nature and the outdoors (NE=89%, MA=87%); experience or challenge of sport fishing (NE=69%, MA=66%); and relax and escape from my daily routine (NE=83%, MA=86%). "The reasons that were rated as not important by the largest proportion of anglers consisted of: fish to eat (NE=42%), to be alone (NE=55%, MA=58%), and to fish in a tournament or when citations were available (NE=79%, MA=73%). In the Mid-Atlantic, although to catch fish to eat was rated as being somewhat important by the largest proportion of anglers (40%), approximately 31% felt that catching fish to eat was very important. However, in New England, only 20% concurred. It is clear from these responses that marine recreational fishing offers much more than just catching fish to anglers. Over 80% of the respondents in both subregions perceived recreational fishing as a time to spend with friends and family, a time to escape from their daily routine, and time to enjoy nature and outdoors. While catching fish to eat is somewhat important to anglers, findings of this survey generally concur with previous studies that found non-catch reasons are rated highly by almost all respondents while catch is very important for about a third and catching to eat fish is moderately important for about another third."

"The economic survey sought to solicit anglers opinions regarding four widely applied regulatory methods used to restrict total recreational catch of the species of fish for which they typically fish: (1) limits on the minimum size of the fish they can keep; (2) limits on the number of fish they can keep; (3) limits on the times of the year when they can keep the fish they catch; and (4) limits on the areas they fish. Anglers were asked whether or not they support or opposed the regulations." As indicated in Table 44, strong support existed for all regulatory methods in both subregions. Limits on the minimum size of fish anglers could keep generated the highest support in both regions (NE=93%, MA=93%), while limits on the area anglers can fish, although still high, generated relatively lower support (NE=68%, MA=66%).

Regulations which limit the number of fish anglers can keep ranked second (NE=91%, MA=88%). The results from this solicitation indicate that recreational anglers in the Northeast Region appear to be conservation oriented and generally support regulations employed to restrict total catch. Not surprisingly, when analyzing anglers' opinions regarding the four widely applied regulatory methods, it was found that anglers in all modes indicated strong support for the regulatory measures. With minimum size limits generating the strongest support, followed by catch limits, seasonal closures, and lastly, area closures. "Although party/charter, private/rental, and shore respondents did offer varying degrees of support for each of a selection of regulatory measures, similar support existed across all modes. Support was highest for common regulatory methods currently being implemented in New England and the Mid-Atlantic (e.g., size and bag limits), than for area and seasonal closures."

2.3.2.2.3 Vessel trip report data

Vessel trip report data (VTR) has been collected by NMFS since 1994 for the recreational and commercial fisheries. In the recreational fishery, this data is collected from party/charter vessels that have permits to operate in federal waters as required by the FMPs or amendments for Summer Flounder, Scup, Black Sea Bass, Northeast Multispecies, and Atlantic Mackerel, Butterfish, and Squids.

Party and charter vessels with a federal permit are required to report all their activities regardless of location (e.g., federal or state waters) when they engage in a fishery for one or more of the species mentioned above. As such, these vessels are required to report all their catches, including bluefish. If a party/charter vessel does not have federal permit as specified above and operates exclusively in non-federal waters, it is exempt from reporting and this activity is not included in the VTR data system (Power pers. comm.).

Vessel trip reporting data indicate that bluefish contributed over 13% of the total catch (by number) made by party/charter vessels in 1996 (Table 45). The contribution of bluefish to the total catch of party/charter vessels fluctuated throughout the year, ranging from 0% in January, February, March, April, and December to 20% in August, with the largest proportion of bluefish caught to other species caught occurring from June through August (Table 45). Analysis of the recreational landings by state indicates that bluefish contributed with less than 1% of the total catch of party/charter vessels in Delaware and Maryland, and over 67% in Connecticut (Table 45).

2.3.2.3 Processing sector, marketing and consumption

Bluefish is primarily a fresh fish product. It is generally iced both on board the vessel and at the dock during unloading before it is shipped to market. The limited extent of the fresh fish market has been one of the major factors constraining the commercial harvest of bluefish. Should methods become available to maintain a quality product over longer periods of time, and current efforts to develop markets in the central portions of the country prove successful, the demand for bluefish and bluefish products could increase. At a local level, demand for bluefish by processors is relatively low, and the market can be saturated quickly. When this occurs, the price for bluefish drops to a low level and, consequently, fishermen target other species (MAFMC 1990a).

A relatively small amount of bluefish is filleted and smoked each year. Slightly more than 2% of bluefish landed in 1983 were processed in this manner (MAFMC 1990a). A number of inquires to NMFS indicated interest in processing bluefish increased in 1986 and 1987 (R. Ross pers. comm.). Most of these inquires concern cured bluefish or bluefish pate rather than fillets. A decrease in New England groundfish stocks and an increase in consumer demand for fish may explain this increased interest.

The price per pound of processed bluefish varies by product type. A telephone survey conducted in 1987 (MAFMC 1990a) indicated that fresh fillets were the most common form of processed bluefish product along the Atlantic coast (averaged $1.43 per pound, wholesale, in constant 1985 dollars). Frozen fillets averaged $0.96 per pound whereas smoked bluefish averaged $3.62 per pound. Smoked bluefish comprised an average of 14% of the total value of the output from the plants that processed them while the fresh and frozen fillets averaged 2% and 1%, respectively.

Along the Atlantic coast between 1992 and 1996, an average of 307,410 lbs of bluefish was processed with an average value of $649,973 (in nominal dollars) (Koplin pers. comm.). The largest volume of bluefish was processed in 1992 at 481,274 lbs ($732,302), and the smallest amount processed was in 1995 (186,591 lbs valued at $493,417). The bulk of the bluefish processing from 1987 to 1996 took place in the New England area. The number of processing plants handling bluefish between 1992 and 1996 along the Atlantic coast averaged 13; total employment at these plants averaged 324 people, and bluefish comprised an average of 2.5% of the total output value and 1.7% of the total output weight.

Four surveys were conducted between 1970 and 1981 which determined per capita consumption of various species of fish. The surveys did not collect usable data on home consumption of recreationally caught fish so results must be interpreted only for seafood obtained through commercial channels. Findings of the four surveys were collated and summarized by Hu (1985) in order to investigate how socio-demographic and economic factors related to seafood consumption over time. Hu found that annual home consumption of bluefish (nationwide) increased from 0.068 lbs per capita in 1973-74 to 0.252 lbs per capita in 1977-78, and then declined to 0.026 lbs per capita in 1981 (though the latter survey measured net edible meat weight only).

In general, more bluefish was consumed by blacks, though consumption by whites increased over time. Also, per capita seafood consumption ranked highest for the Atlantic coast region and urban dwellers generally consumed more than suburban/rural residents. These observations are consistent with marketing practices for fresh bluefish. While per capita consumption of seafood in general exhibited a positive association with income, findings specific to bluefish showed negative income elasticities for both expenditures and quantity consumed. The 1981 survey indicated that most (78.8%) bluefish was consumed at home rather than away from home.

An August 1987 survey of Atlantic states retailers selling bluefish revealed an average price for bluefish fillets of $2.46/lb (MAFMC 1990a). Based on a ratio of 2.5 pounds of round fish to one pound of fillets, the 1987 commercial bluefish landings were worth $14.5 million retail. This estimate assumes all bluefish landings become bluefish fillets, though in fact some fish are sold whole and a small portion of landings are processed into other products. The estimate of retail value presented here may be high or low, depending on the actual proportions sold as each product type (i.e. whole, smoked, etc.) and the relative values and quantity sold in each state.

Sufficient data at the retail level (supermarkets, food service, and restaurants) are not available to estimate a demand schedule for bluefish by final consumers. Such a schedule is necessary to estimate total willingness to pay for bluefish products. The marginal retail value (taken to be $2.46/lb by the assumptions above) can be used to assess impacts of changes in commercial landings, however, for small changes in quantity.

Several factors could expand consumer demand for bluefish. Heightened awareness of the healthfulness of fishery products has generated an increase in per capita seafood consumption to record levels in the U.S. (USDC 1987b). In addition, regional dishes such as blackened fish have increased restaurant purchases of certain species. Changes in consumer preferences could increase the demand for commercially caught bluefish. However, prices, income and the availability of substitute seafood products will undoubtedly affect further development of the bluefish market.

2.3.2.4 International trade

Bluefish are widely distributed and are caught by a number of countries in most of the world's oceans (MAFMC 1990a). World-wide, most commercially landed bluefish come from the Mediterranean and Black Seas. However, commercial landings from these areas have decreased from 54% (42 million lbs) of the world's total in 1993 to 34% (15 million lbs) in 1995. Turkey has traditionally been the number one commercial supplier of bluefish. In 1993, Turkey had the highest commercial world-wide landings of bluefish with 47% of the total, followed by Brazil (16%) and the United States (14%). In 1995, Turkey accounted for 25% of the total world production, followed by Brazil (30%) and the United states (20%). In recent years, Brazil and the United States have ranked second and third place in the total world landings of bluefish. From the mid 1980's to the mid 1990's, Venezuela has emerged as another major commercial supplier.

There is no data on the amount of bluefish that is either imported or exported. Bluefish is lumped under "other species" export code, and because of this, cannot be identified in the U.S. trade data (Koplin pers. comm.). However, some limited trade information from a special report on trends in exports of federally inspected fish is available (Dougherty and Brown 1982). Dougherty and Brown (1982) reported that 1.4 million lbs of bluefish were inspected by NMFS for export between 1 October 1980 and 30 September 1981. Of this total, 1 million lbs were destined for Venezuela, 77,000 lbs for Nigeria, and 338,000 lbs for the West Indies. Though over 50% of the fish exported from the southeastern U.S. was federally inspected (Dougherty and Brown 1982), the lack of complete coverage leaves open the possibility that more bluefish were exported out of this region.

United States bluefish exports from 1981 to 1986 were much lower than the 1980 level and varied from 2,400 lbs valued at $1,500 in 1983 to 205,900 lbs valued at $91,900 in 1986 (MAFMC 1990a). Exports averaged less than 1% of commercial landings over this period, indicating either saturation of the world market or its inaccessibility to U.S. processors. Most exports were frozen; only 8,400 lbs of fresh bluefish were shipped from 1981 to 1986.

2.3.2.5 Administrative, enforcement, and information costs

The proposed amendment introduces various new permits in addition to a framework provision including a minimum mesh size. Law enforcement's resources needed to balance and maintain consistent dock side coverage and effect the bluefish fishery in a manner intended by the amendment, are the addition of two Full Time Equivalents (FTEs) for two officers. As such, the total cost required to enforce new management measures is estimated at $200,000 ($110,000 per FTE).

Compliance costs for participants are described in section 3.1.4. The expected burden costs for the commercial permits for bluefish (commercial fishing vessels are licensed) are $1,878 for the public ($8 per vessel) and $8,217 for NMFS. The estimated burden costs associated with public requirements for the commercial logbook submission is $4,959 ($20 per vessel per year), and the total associated government cost is $6,223. The cost associated with vessel identification (vessels requiring new commercial permits) is estimated at $5,291 ($21 per vessel). The expected burden costs associated with public and government requirements for the dealer permit during the first year are $45 ($1 per dealer) and $1,221, respectively. Thereafter, the yearly cost associated with submitting weekly dealer reports is $26 per dealer and $1,601 for NMFS.

2.3.2.6 Prices to consumers

Average exvessel price of bluefish (1996 adjusted dollars) varied from $0.13 to $0.35 per pound for the period 1985-1996. Exvessel price was highest in 1995 at $0.35 per pound. In 1996, bluefish exvessel price per pound was $0.30 coastwide (Table 37).

Potential reductions in landings and value attributed to this amendment in its early years are not expected to significantly increase overall exvessel bluefish price. Future increases in bluefish supply due reduction in mortality, higher harvest weight, and stock rebuilding should maintain the consumer bluefish price level.

2.3.2.7 Redistribution of costs

The amendment is designed to give fishermen the greatest possible freedom of action in conducting business and pursuing recreational opportunities consistent with the objectives. It is not anticipated that the proposed management measures will redistribute costs between users or from one level of government to another.

2.3.3 Preliminary 1997 Estimates for the Recreational and Commercial Fisheries

Preliminary MRFSS data indicates that 13.6 million lbs of bluefish were landed by recreational anglers along the Atlantic coast in 1997. This represents a decrease of 1.1 million lbs from the 1996 recreational landings. Preliminary commercial landings data indicate that 9.0 million lbs of bluefish were landed along the Atlantic coast by commercial fishermen in 1997. This represents a decrease of 0.29 million lbs from the 1996 commercial landings.

2.3.4 Port and Community Description

The Mid-Atlantic Fishery Management Council commissioned a report to describe the people and communities involved in the region's fisheries. The report, titled "Part 2, Phase I, Fishery Impact Statement Project, Mid-Atlantic Fishery Management Council" by McCay *et al.* (1993), was developed to assist in describing the potential effects of management actions on the people and communities involved in fisheries throughout the region. The McCay *et al.* report (1993) is the best available data for description of port and community involvement and in fact is the only systematic coastwide description currently available.

The principal approaches employed to compile the information presented in this report were open-ended phone interviews, port visits, data analysis, and interviews of people involved in different aspects of the fishing industry.

The report prepared by McCay *et al.* (1993) identified ports that appeared in the top 10, in terms of landed value, for any of the species that the Mid-Atlantic Fishery Management Council has full or shared responsibility for the preparation of Fishery Management Plans (tilefish, scup, black sea bass, summer flounder, dogfish, Atlantic mackerel, *Loligo* squid, *Illex* squid, butterfish, weakfish, bluefish, and angler or monkfish). The ports identified as relevant in the first report covered ports from Chatham, Massachusetts, to Wanchese, North Carolina.

Landing statistics and values are from the National Marine Fisheries Service weighout data. Information about the ports is from interviews with key informants and from earlier studies conducted by McCay's research team (McCay *et al.* 1993).

The descriptive information that follows is excerpted and paraphrased from a report prepared for the Council by McCay *et al.* 1993 and is based on interviews conducted in the respective ports:

<u>Wanchese, North Carolina</u>

"Wanchese has traditionally been a fishing community with commercial fishing operations since the late 1800s. Many of the current residents of Wanchese are descendants of people who settled here in the late 1600s and early 1700s." Many of the fishers are small, independent owner operators. "Informants have estimated that fifty percent of the men in Wanchese are in a marine related career." Wanchese has never developed the strong tourism sector seen in nearby areas. Because of the periodic shallowness of Oregon Inlet, many of its larger trawlers stay in Hampton, Virginia or New Bedford, Massachusetts during the winter. "Wanchese is also the site of the Wanchese Seafood Industrial Park (WSIP) which was developed in the 1970s to be a major site for seafood processing activities. However, because of the uncertain nature of Oregon Inlet and the general decline in fisheries since the 1970s, very few businesses actually operate in WSIP. The catch is either sold at retail markets locally or it is packed in ice and sent to other markets. At least one of the Wanchese commercial fishing and packing operations has expanded to other ports such as Hampton, Virginia and New Bedford, Massachusetts." In recent years, some New Bedford vessels have moved south to base in Wanchese in response to shortages of groundfish and scallops in New England.

Much of Wanchese ocean fishing occurs in the winter months (November-April). However, the boats in Wanchese fish all year round. Bluefish is predominantly caught with ocean gill nets which fish up to ten miles offshore and in the area of Ocracoke to Currituck Light. Other species include weakfish, dogfish and Atlantic croaker between the first of November and the end of April. There are a half dozen fish houses and other marine-related businesses that handle species other than crabs, and a couple that handle crabs exclusively. McCay *et al.* (1993) reported that summer flounder (21%) was the most important species in Dare County in terms of landed value in 1991. The value of all species landed in Dare County was over $11 million in 1991. Blue crabs (hard) are second in importance (11%), followed by weakfish (9%). Other species of volume in Dare County in 1991 were bluefish (4.02%), sea basses (3.41%), dogfish (1.00%), tilefish (0.53%), scup (0.41%), butterfish (0.31%), squid (0.29%), and Atlantic mackerel (0.12%).

Generally, the boats that are owned by local companies are operated by hired captains. However, these boats may be operated by a relative in some instances. Independent boats are usually owner-operated, with family members often serving as crew. "The crew on these vessels are mostly local; 75-80% are from within the area. All are paid with some variation of a share system." The crews are mostly 18 to 40 years of age; captains are usually older, with some over 65. Most crew members are white, though there are some black fishers including black captains. Sometimes, members of a family will own boats and fish houses. In the fish houses, most of the work force are black women, except for the crab houses where Latino workers are more common."

Recreational fishers use the inshore, offshore, and sound waters around Wanchese in Dare County. Those fishing from boats do not predominantly target bluefish. Bluefish are targeted by pier and surf fishers, who are primarily local residents and residents of nearby counties. Other species targeted by pier and surf fishers are flounder, Kingfish or sea mullet, triggers, puffers, skates, rays, spot, pigfish, and pinfish.

Hampton/Hampton Roads, Virginia

The area in Virginia containing Hampton, Newport News, Seaford, and Virginia Beach is known as Hampton Roads. It is difficult to describe fishing in Hampton apart from the rest of the area. These ports have historically been fishing communities. The Hampton Roads area included five of the six major offloading ports in Virginia. However, the fishing industry is but one of the many industries in the Hampton Roads area. While Hampton itself is not a big tourist spot, the town is trying to emphasize its waterfront area and its tourism potential. There is an Air and Space Museum, a marina for pleasure boats, a number of military installations, and a large coal port in addition to other shipping."

Much of the landed fish in Virginia by weight is accounted for by menhaden, but other species are also important. Bluefish accounted for 0.16% of the total landed value in Hampton Roads in 1992. Seventy-seven percent of the bluefish landed were caught by draggers and 19% by sink netters. "One informant said that bluefish is a bycatch for the flounder fishing otter trawlers." Otherwise, there is not much commercial bluefishing in the Hampton Roads area. Overall, the fishers in this area are very opportunistic, targeting whatever is available and marketable.

Family ties are important in choosing crew members on the smaller vessels. These boats tend to have very stable crews. Larger vessels, especially scallopers, have a much higher turnover rate among crew. Crew are paid on a share system. Most of the captains and some of the crew have been fishing for most of their lives. Educational levels vary. "There is a mix of age groups in commercial fishing in Hampton Roads. One informant said that for a while, there was concern that there were no younger people getting into this industry. A few younger people have joined fishing recently with the recession and the scale down in the military." There is a small but growing contingent of Vietnamese-owned boats, which is generating some resentment from longtime resident fishers. There are also a small number of Mexican-American fishers, most of whom are members of a single extended family.

"Trawlers unload at packing houses and these fish houses often serve as the wholesale buyer and distributor. One of the fish houses has government contracts and supplies the navy with all of its seafood. Bluefish are shipped north to Philadelphia or New York City. Two of the companies in Hampton own their own trucks and one of these is also a secondary buyer."

"Hampton Roads also has a large recreational fishery. Virginia Beach has a sports fishing center like Ocean City, Maryland but not as big as Oregon Inlet, North Carolina." Summer flounder is an important recreational species with hook and line, with the highest recreational landings in the spring near Chincoteague (eastern shore). Headboats go out for black sea bass, and some recreational fishers target scup. Other recreational species include bluefish and weakfish, with dogfish being an incidental catch. "Bluefish are a recreational fish in the early summer in inshore waters."

Ocean City, Maryland

"The principal port in Maryland is Ocean City. Ocean City is a commercial fishing community with families that have been involved in fishing for at least sixty years. In the last [twenty] years, Ocean City has grown into its current status as a summer resort area. However, new development is not taking place at the same levels as it did in the past. In fact, fishers are also finding it hard to go into other industries such as crabbing or construction because these are depressed as well." Surf clams and ocean quahogs are the two most important species, but summer flounder, black sea bass, sea scallops, bigeye tuna, swordfish, spiny dogfish, and yellowfin tuna are also species of interest. Bluefish is not an important species in this port.

Draggers take a variety of species, but primarily summer flounder and spiny dogfish. They trawl year round for summer flounder, black sea bass, and scup. From April through September they target summer flounder almost exclusively. Black sea bass are important species for inshore handline fishers. There has also been a significant sea bass pot fishery, with black sea bass landed value being second only to summer flounder in many years, though it has seen some decline recently. The black sea bass pot fishery runs from April to September. The top ten species by value (1992) landed in Ocean City are surf clam (34.09%), ocean quahog (28.04), summer flounder (4.83%), black sea bass (4.69%), sea scallop (4.07%), bigeye tuna (3.94%) swordfish (3.78%), spiny dogfish (3.66%), yellowfin tuna (3.62%), and lobster (1.51%). Bluefish ranked 29th in importance, accounting for 0.10% of the total landed value in this port.

"Most of the vessels in Ocean City are owner-operated but a few hire captains. Most owners pay their crew by the share system. A few African-Americans are in the crews and at least one boat had an African-American captain." Captains range from age 23 and up.

"Businesses that serviced the surf clam and ocean quahog fishery such as trucking, fuel and ice have declined tremendously. There are unloading areas in Ocean City as well as local buyers. Fluke [summer founder] and black sea bass are taken to New York or Norfolk to bigger fish houses. During the summer, more summer flounder is sold locally and in Baltimore. Big-eye tuna and the best yellowfins go to Japan and bring a lot of money per pound."

"Ocean City is a well known recreational fishing port with many offshore charter boats." Pelagic boats target white marlin, as also tuna, bluefins, and big eyes. Atlantic mackerel are also popular targets.

<u>Belford/Pleasant Point/Barnegat Light/Long Beach, New Jersey</u>

Belford's fleet is mostly in the 40-60 foot range and most vessels are older. This is a family based fishing port, with draggers, pound netters, and lobster potters predominating. Most of the fish are handled by a local cooperative, with other firms handling lobster and shellfish. There is little or no tourism. Point Pleasant is more diverse and larger. It is less dominated by family businesses. There are half a dozen fish houses, including a cooperative. There are also a lot of marine-related industries and a strong tourist sector. Barnegat Light is heavily tourism oriented in the summer but becomes more dependant on fishing in the winter.

Most boats in these ports are owner-operated, and there are no freezer boats. Whiting is an important species, as are surf clams and ocean quahogs. There is a bluefish poundnet fishery in Sandy Hook Bay. In Belford, bluefish accounted for less than 2% of the total landed value for all species in 1992. In Belford, there is a sink gill-net fishery, which accounted for 0.6% of the total landed value in 1992. It is dominated by weakfish (50%) and bluefish (39%), and also includes butterfish, summer flounder, dogfish, black sea bass, and scup. Run-around gill nets are sometimes used for bluefish. In Point Pleasant, bluefish accounted for less than 1% of the total landed value by all species in 1992. In Point Pleasant, weakfish, bluefish, mackerel, little tunny, and scup are major species landed by gill net boats. Some bluefish are also landed by hand line gear. In Barnegat Light/Long Beach Island, bluefish accounted for less than 2% of the total landed value by all species in 1992. Bluefish are landed at various times of the year by gill netters. Captains tend to be aged 40-60. "Belford is a place where fishers have little other skilled work experience and thus are particularly dependent on fishing."

There is a charter boat fleet in Barnegat Light which targets mostly bluefish, summer flounder, and tuna.

Cape May/Wildwood, New Jersey

Cape May "is noted for its tremendous tourist and beach economy during the summer. While there are marinas in town, there is little conflict for space with commercial fishers because the commercial docks are separated from the rest of the community." The general outline of the area fisheries indicate that bluefish are caught by gill netters and they are a bycatch for draggers. In Cape May/Wildwood, bluefish accounted for less than one quarter of a percent of the total landed value for all species in 1992. There are only a few gill netters in Cape May. For the Cape May/Wildwood area, the sink gill net fishery accounted for 0.69% of the total landed value in 1992. However, the gill-netters are almost totally dependent on few species: dogfish (41% landed value), weakfish (27%), and bluefish (11%). Other species caught included angler, summer flounder, scup, Atlantic mackerel, and butterfish. The draggers are generally 50-75 feet long, steel hulled, and specialize in scup and summer flounder. "In addition to local boats, a large number of transient boats from North Carolina, Virginia and some northern states land here." The number of boats has been fairly stable recently, however, perhaps due to the great diversity of species landed here.

Brooklyn/Freeport, New York

Vessels originating from these ports are primarily draggers fishing for whiting, summer flounder, winter flounder, *Loligo* squid, and scup. There are also lobster boats in these ports. Most are day boats who take an occasional 48 hour trip for squid. Most boats are owner-operated. "According to one informant, the gill netters target bluefish, weakfish, butterfish, and mackerel." Pay is by the share system. There is also a substantial amount of tourism, with numerous charter boats based in Freeport.

Stonington, Connecticut

Species of importance in the area include lobster, quahog, summer flounder, winter flounder, and squid. "Bluefish are abundant and is caught primarily by handliners and draggers, but there is no market for it in Stonington." Menhaden, bluefish, black sea bass, alewife, and weakfish are important components of the drift gill net fishery. The number of boats in Stonington is stable. Most fishers are of Portuguese descent. The share system is typically used. There are several fish dealers who sell to markets in Baltimore, Philadelphia, Boston, and New York, or directly to local fish markets.

Newport/Other Washington County, Rhode Island

"Three ports make up the bulk of the landings in Rhode Island: Point Judith, Quonset Point, and Newport. Point Judith is generally a "wetfish" port, where the fish is most often landed on ice and packaged at port. Newport is similar. Quonset Point is strictly a large factory freezer vessel port. Newport traditionally landed groundfish and lobster, but in the early 1990s began targeting squid, mackerel, butterfish, scup and dogfish."

"Groundfishing boats, a few scallopers, gill-netters, and draggers make up the range of boats in Newport. While Newport's fish potters rely almost entirely on scup, they also catch a little tautog, small amounts of black sea bass, bluefish, and summer flounder, among other species"

"Newport's small gill-net fishery relies heavily on anglers, as well as its traditional cod, tautog, and bluefish catches. Newport's gill-netters also land the majority of spiny dogfish. They also land large amounts of weakfish and small amounts of *Loligo* squid." Newport's floating trap fishery targets among others: scup, bluefish, summer flounder, Atlantic mackerel, black sea bass, and *Loligo* squid.

Bluefish is not a major species landed in Point Judith. Point Judith harbors some minor fisheries. Besides lobster, pot fisheries are heavily reliant on scup, and pots catch a small percentage of black sea bass, as well as tautog, conger eel, and small amounts of bluefish. Point Judith's small gill net fishery depends heavily on angler, as well as cod, dogfish, tautog, and other species. Bluefish, Atlantic mackerel, summer flounder, black sea bass, weakfish, and butterfish in small quantities are landed in the gill-net fishery. Angler are caught predominantly by draggers, accounting for the bulk of the total landed value for the dragger fishery in 1992. Bluefish, butterfish, summer flounder, scup, black sea bass, squids, and weakfish are also landed by draggers.

Newport has several commercial fish packing and distributing firms, but is also heavily oriented to yachting and tourism. Few non-fishing jobs are available, however. Point Judith is almost exclusively a fishing town, though there is some summer tourism, mostly related to Block Island. The Point Judith coop employed some local labor as well, but is now closed.

New Bedford, Massachusetts

"The dominant gear types in new Bedford are scallop dredges and otter trawls." Angler, summer flounder, spiny dogfish, *Loligo* squid, and scup are among the most important species landed in New Bedford. Some bluefish is landed by draggers and gill netters. "There is no directed fishery for bluefish in New Bedford, the bluefish which is caught is incidental bycatch."

Chatham, Massachusetts

"Chatham is a seasonal resort community. It is a wealthy community and property values are very high. Sportfishing and commercial fishing are important to the community. However they do not seem to be the mainstays of the community's economy. Chatham's fishing community is divided between two ports, Chatham Harbor on the east coast of town, and Stage Harbor on the south side of town. Scup, fluke, sea bass, mackerel, butterfish, weakfish and bluefish are caught as miscellaneous fish by Chatham Harbor boats." Bluefish is not an important species in this port.

Chatham boats are all under 50 feet and are owner-operated. Most crew are paid by the share system, but others are paid by the day or are wage workers.

Other North Carolina locations

In the work conducted by McCay *et al.* (1993), the only port described in North Carolina was Wanchese. This section further describes the general characteristics of fishing activities in North Carolina. The descriptive information that follows is excerpted and paraphrased from a report prepared by Griffith (1996) and is based on visits to fishing centers around the state, surveys, and in depth-interviews.

The information presented in this section is based on the following visited locations: Swan Quarter, Englehard, Rose Bay, Germantown, and Ocracoke in Hyde County; Belhaven and Aurora in Beaufort County; Hatteras, Wanchese, and Alligator River in Dare County; Atlantic, Stacey, Beaufort, and Salter Path in Carteret County; Vandamere and Paradise in Pamlico County; Sneads Ferry and Hampstead in Oslow County; and Varnumtown in Brunswich County.

The following are the seven most notable general characteristics of fishing activities in North Carolina according to Griffith (1996).

"First, most obviously, the busiest fishing season for almost all sites visited begins in the spring and lasts through summer, with December through February being relatively quiet in most locations. Exceptions to this are the fisheries of the Outer Banks, which tend to be net-based and to target winter species. Second, despite the fact that we find a number of extremely large vessels in the state, crews on most vessels tend to be small (<45'). Most crews consist of between one and three fishermen and many interviewed fishermen fish alone. The menhaden fishery, of course, is an exception to this (Garrite-Blake 1995). Third, relatively few sites we visited specialize in only one species, one type of gear, or one type of vessel. Crab pots and shrimp or otter trawls rank high among the principal gears used in the state, but others tend to be found in use alongside these either by the same fishermen or by others using the same docking and other facilities. Fourth, few full-time, owner-operator North Carolina fishermen rely on a single species or single gear for their livelihood, and many operate from more than one vessel; indeed, this diversity and flexibility constitutes one of the central defining characteristics of a full-time fishermen in North Carolina. Small crew sizes, especially those based on family and community relations, are adaptive under these conditions, where shifting among fishing gears and locations does not depend on mobilizing large numbers of crewmen. Fifth, this diversity and flexibility has some implications for managing the fisheries of the state. Although fishermen tend to be defined by the *primary* species they target and gear they use to capture those species, such as shrimpers using otter trawls or crabbers using crab pots, North Carolina fishermen become more alike one another, often, in the *secondary* species they target and, in particular, the gears they use for those species. Sixth, North Carolina fisheries are highly localized. Those sites with access to both inland and off-shore waters, such as fishermen based in Wanchese or the Outer Banks or Carteret County, have more options available to them to switch among fisheries and even between recreational and commercial sectors (such as operating as charter boat fishermen) than fishermen based along the Pamlico River or Albemarle Sound. Some fishermen, recognizing the advantages to these different locations, dock boats at more than one location or utilize more than one launching facility. However, several fishermen we interviewed had little or no idea about the character of fisheries fewer than fifty to sixty miles away. Seventh, regional differences occur among the fisheries as we move from North to South, yet are more pronounced as we move from East to West. For example, those fishermen who fish in the Albemarle Sound are more like fishermen of the Pamlico River than they are like those who operate out of Wanchese. Urban and rural distinctions also figure into these differences, fishing strategies of around the Nags Head/Manteo are more similar to Morehead City and Wilmington fishing strategies than they are toward those of Eastern Dare further down the Outer Banks. Finally, with the exception of crab processing plants, most shore sites are staffed by relatively few people on land; most of the work of off-loading, icing, and other handling of the catch is done by fishermen."

Regarding the present aspects of the fishery in the area, it was found that "North Carolina's principal fisheries have changed considerably through time, yet certain historical continuities thread through the fishing lifestyles we find on the coast from prehistoric and colonial times to the present." Some families in the Tidewater area (Hyde County) still depend on combining commercial crabbing, eeling, gill net fishing, trapping, hunting, and hiring out as guides to hunters and sportfishermen. Individuals around the upper reaches of the Albemarle Sound still string together seasonal work in the herring fishery, hunting, logging, and from time to time, farming. "Two of the earliest fisheries in North Carolina provided an organizational template for fisheries that continue, in altered form, today. The early herring fisheries on the Chowan River and the Albemarle Sound were highly capitalized fisheries in which harvesting and processing were as tightly integrated as today's menhaden fishery."

Due to the lack of a license for sampling purposes, saltwater recreational fishing in North Carolina is hard to track and monitor. In order to assess recreational and other non-commercial (e.g. subsistence) fishermen, a structured interview with 178 individuals in these fisheries was conducted in order to address this lack of information. Interviewed fishermen were overwhelmingly white males (95%) between 21 to 79 years of age (average of 48 years). Twenty-five percent were between 20 to 41 years of age, 25% were between 40 to 48 years of age, 25% were between 47 to 59 years of age, and the remaining 25% were over 59 years of age. The majority (89%) were North Carolina residents; only 7% had not finished high school, and over 60% had some training or education after high school. About 77% were married at the time of the interview, with 11% never having married and the remainder either divorced/separated (7%) or widowed (4%). About 42 % lived in households with more than two children, and only 13% were retired. Influenced by the sampling methodology, 41% of the interviewed fishermen fish most frequently from manmade structure, 34% from private boats, 19% from the beach or bank, and the remainder from other places such as charter boats or a combination of the previous fishing modes. About 79% of those interviewed primarily fish in state waters (rivers, sounds, or less than 3 miles from shore), with 13% fishing more than 3 miles from shore, and the majority (83%) rarely fishing in freshwater. "Anglers interviewed fish from one to 330 days per year. Average fishing effort is around 42 days/year, which would be 80% of the weekend, yet this varies widely within the sample. When they do fish, although slightly more than a third of the population has no target species (35%), the most commonly sought species include: King mackerel, flounder, trout, spot, bluefish, and Spanish mackerel. They catch these species, of course, primarily with hook and line...around one third eat 100% of their catch and 3% eat none of their catch. Around three-fourths give their catch away (usually half what they catch), and under 10% sell their catch. Boat ownership is relatively common among those interviewed, with 58.4% reporting that they owned boats."

Regarding fishermen carrying passengers for hire, "charter boat captains occupy a position between recreational and commercial fishermen and, in fact, often move between winter commercial fishing and running charter during the summer. A few we interviewed for this study come from long family traditions of fishing, both commercially and as recreational boat captains, and maintain strong social links with commercial fishing centers in the state. Of course, nearly all of their business as charter boat operators occurs during the summer months and most of their clients are tourists, but charter boat captains reported fishing heavily into the fall and beginning in the late spring."

3.0 ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES

3.1 MANAGEMENT ALTERNATIVES

3.1.1 Preferred Measures to Attain Management Objectives

3.1.1.1 Specification of OY, DAH, DAP, JVP, and TALFF

Section 600.310 (b) states that the determination of OY is a decisional mechanism for resolving the Magnuson-Stevens Act's multiple purposes and policies, implementing an FMP's objectives, and balancing the various interests that comprise the national welfare. OY is to be based on MSY, or on MSY as it may be reduced for social, economic, or ecological reasons. The most important limitation on the specification of OY is that the choice of OY and the conservation and management measures proposed to achieve it must prevent overfishing.

OY is all bluefish harvested pursuant to this FMP as determined by the overfishing definition and rebuilding schedule detailed in this amendment. OY will change as the fishing mortality rate target varies and is dependent on the level of stock biomass.

The Council has concluded that U.S. vessels have the capacity to, and will, harvest the OY on an annual basis, so DAH equals OY. The Council has also concluded that U.S. fish processors, on an annual basis, will process that portion of the OY that will be harvested by U.S. commercial fishing vessels, so DAP equals DAH and JVP equals zero. Since U.S. fishing vessels have the capacity and intent to harvest the entire OY, there is no portion of the OY that can be made available for foreign fishing, so TALFF also equals zero.

3.1.1.2 Rebuilding schedule

The Sustainable Fisheries Act (SFA) requires the Council to set the overfishing definition to meet a new standard (F_{MSY}). In addition, the resource must be rebuilt to the biomass associated with MSY, B_{MSY}, in as short a period as possible. The rebuilding period is not to exceed 10 years, except where biology, environmental conditions, or international agreements dictate otherwise.

In an update to the most recent assessment for bluefish, Gibson and Lazar (1998a) found that current fishing mortality for bluefish exceeds the threshold fishing mortality rate (F_{MSY}). In addition, total stock biomass of bluefish is currently 23% of the target biomass (B_{MSY}). Thus, the Atlantic coast bluefish stock is considered overfished according to the new SFA overfishing guidelines and requires rebuilding. This amendment addresses the overfishing problem and plans to rebuild the resource to meet SFA requirements over a nine year planning horizon.

The preferred rebuilding schedule is a graduated step reduction in fishing mortality of 40% over a nine year period (1999 to 2007) to rebuild the biomass target (B_{MSY}). This recovery schedule will eliminate overfishing according to the newly revised overfishing definition. It will also allow for rebuilding of the bluefish stock to a level that could produce MSY on a continuing basis in 9 years. The recovery schedule associated with this alternative is displayed in Table 46. During the rebuilding period, the target F for the next fishing year would be set at the level specified in the rate reduction schedule or the level estimated for the most recent year, whichever is less.

Under this preferred management alternative, the total allowable catch (TAC) for 1999 would be 36.84 million lbs (16,710 mt) (Table 46). The projected yields include commercial landings and recreational catch. As such, an estimate of recreational discards must be subtracted from the TAC to derive a total allowable landings (TAL). Discards would be estimated for each year and subtracted from the annual TAC to derive the TAL for that year. In 1999, 1.82 million lbs (825 mt) of discards would be deducted from the TAC to yield a TAL of 35.02 million lbs (15,885 mt) (Table 47). This discard level (825 mt) is equal to the average recreational discards for the period 1993 to 1996.

3.1.1.3 Permit requirements: commercial and party/charter vessels

Any owner of a vessel desiring to fish for bluefish within the US EEZ for sale, or transport or deliver for sale, any bluefish taken within the EEZ must obtain a federal commercial permit from NMFS for that purpose.

Any owner of a party/charter vessel carrying recreational fishermen for hire to fish for bluefish within the U.S. EEZ must obtain a party/charter vessel permit from NMFS for that purpose.

A recreational vessel, other than a party or charter boat (vessel for hire), is exempt from the permitting requirement if it catches no more than the recreational possession limit, multiplied by the number of persons on board, of bluefish per trip.

A party and charter boat may have both a party or charter boat permit and a commercial permit to catch and sell bluefish. However, such a vessel may not fish under the commercial rules if it is carrying passengers for a fee. When a party or charter boat is operating as a commercial vessel, the crew size must not be more than 5 when operating as a party boat and not more than 3 when operating as a charter boat.

The federal costs of implementing an annual permit system for the sale of bluefish shall be charged to permit holders as authorized by section 303(b) (1) of the Magnuson-Stevens Act. In establishing the annual fee, the NMFS Regional Administrator will ensure that the fee does not exceed the administrative costs incurred in issuing the permit, as required by section 304(d) of the Magnuson-Stevens Act.

The Commission has established compliance criteria as a part of the interstate management process (see section 5.1.4.1). The states would be required to implement a permit system for vessels catching bluefish exclusively in state waters. In cases where states already have permit systems in place as called for in this amendment, then the amendment will allow implementation of mechanism consistent with the Atlantic Comprehensive Coastal Statistics Program to eliminate duplicate state/federal permits.

3.1.1.4 Dealer permits and fees

Any dealer of bluefish, including party/charter vessel operators who sell fish to the public, must have a permit. A dealer of bluefish is defined as a person or firm that receives bluefish for a commercial purpose from a person possessing a commercial bluefish permit pursuant to this FMP for other than transport.

An applicant must apply for a federal dealer permit in writing to the Regional Administrator. The application must be signed by the applicant and submitted to the Regional Administrator at least 30 days before the date upon which the applicant desires to have the permit made effective. Applications must contain the name, principal place of business, mailing address, and telephone number of the applicant. The Regional Administrator will notify the applicant of any deficiency in the application. If the applicant fails to correct the deficiency within 15 days following the date of notification, the application will be considered abandoned. Except as provided in Subpart D of 15 CFR Part 904, the Regional Administrator will issue a permit within 30 days of the receipt of a completed application.

A permit expires on 31 December of each year or if the ownership or the dealer changes. Any permit issued under this section remains valid until it expires, is suspended, is revoked, or ownership changes. Any permit which is altered, erased, or mutilated is invalid. The Regional Administrator may issue replacement permits. Any application for a replacement permit shall be considered a new permit.

A permit is not transferable or assignable. It is valid only for the dealer to whom it is issued.

The permit must be displayed for inspection upon request by an authorized officer or any employee of NMFS designated by the Regional Administrator.

The Regional Administrator may suspend, revoke, or modify, any permit issued or sought under this section. Procedures governing permit sanctions or denials are found at Subpart D of 15 CFR Part 904. The Regional Administrator may, after publication of a notice in the *Federal Register*, charge a permit fee. Within 15 days after the change in the information contained in an application submitted under this section, the dealer issued the permit must report the change in writing to the Regional Administrator.

The Commission has established compliance criteria as a part of the interstate management process (see section 5.1.4.1). The states would be required to implement a permit system for dealers who sell fish caught in state waters. In cases where states already have permit systems in place as called for in this amendment, then the amendment will allow implementation of mechanism consistent with the Atlantic Comprehensive Coastal Statistics Program to eliminate duplicate state/federal permits.

3.1.1.5 Operator permit and fees

Any individual who operates a vessel for the purpose of fishing commercially for bluefish (i.e., possesses a valid commercial permit to sell bluefish) or the operator of a vessel with a party/charter boat permit must have an Operator's Permit issued by NMFS or a state. Any vessel fishing commercially for bluefish or recreationally with a party/charter boat permit must have on board at least one operator who holds a permit. That operator may be held accountable for violations of the fishing regulations and may be subject to a permit sanction. During the permit sanction period, the individual operator may not work in any capacity aboard a federally permitted fishing vessel.

The federal permit program has the following requirements:

1. Any operator of a vessel fishing for bluefish (either commercial or party/charter) must have an operator's permit issued by the NMFS Regional Administrator.

2. An operator is defined as the master or other individual on board a vessel who is in charge of that vessel (see 50 CFR 620.2).

3. The operator is required to submit an application, supplied by the Regional Administrator, for an Operator's Permit. The permit will be issued for a period of up to three years.

4. The applicant would provide his/her name, mailing address, telephone number, date of birth, and physical characteristics (height, weight, hair and eye color, etc.) on the application. In addition to this information, the applicant must provide two passport-size color photos.

5. The permit is not transferable.

6. Permit holders would be required to carry their permit aboard the fishing vessel during fishing

and off-loading operations and must have it available for inspection upon request by an authorized officer.

7. The Regional Administrator may, after publication in the *Federal Register*, charge a permit fee.

The specific requirements for a state operator permit will be determined by each state. In cases where states already have permit systems in place as called for in this amendment, then the amendment will allow implementation of mechanism consistent with the Atlantic Comprehensive Coastal Statistics Program to eliminate duplicate state/federal permits.

3.1.1.6 Bluefish FMP Monitoring Committee

The Bluefish Monitoring Committee is a joint committee of the Council and Commission that will be made up of staff representatives of the Mid-Atlantic, New England, and South Atlantic Fishery Management Councils, the Northeast Regional Office, the Northeast Fisheries Center, and Commission representatives. The Commission representatives will include the Bluefish Plan Review Team as established per section 5(e) of the Commission Interstate Fisheries Management Program Charter. The Council Executive Director or his designee will chair the Committee.

The Bluefish Monitoring Committee will annually review the best available data including, but not limited to, commercial and recreational catch/landing statistics, current estimates of fishing mortality, stock status, the most recent estimates of recruitment, VPA results, target mortality levels, beneficial impacts of size/mesh regulations, as well as the level of noncompliance by fishermen or states and recommend to the Council Committee and Commission Bluefish Management Board commercial (annual quota, minimum fish size, and minimum mesh size) and recreational (possession and size limits and seasonal closures) measures designed to assure that the target mortality level for bluefish is not exceeded. The Committee will also review state regulatory programs for consistency with the FMP. The Committee will also review the gear used to catch bluefish to determine whether gear other than otter trawls and gill nets need to be regulated to help assure attainment of the fishing mortality rate target and propose such regulations as appropriate.

The Council and Bluefish Management Board will receive the report of the Committee as well as appropriate public input. The Council and Management Board will consider this information and jointly determine the quota and framework adjustments for the following year. Next, the Council will make its recommendations to the Regional Administrator and the Board will determine the final state quota and other state management measures for the year. The Regional Administrator will receive the report of the Council and publish a report in the *Federal Register* for public comment by the date specified in the regulations which provides states sufficient time to implement quotas and other management measures. Following the review period, the Regional Administrator will set the final federal quota and other management measure adjustments for the year.

In summary, the steps from the Monitoring Committee to action by the Council, Commission and Regional Administrator are:

1. The Monitoring Committee reviews the data and makes recommendations to the Coastal Migratory Species Committee and Commission Bluefish Management Board.

2. The Commission and Council Citizens Advisory Panels may meet and may present recommendations to the Committee and Board.

3. The Coastal Migratory Committee and Bluefish Management Board consider the

recommendations of the Monitoring Committee, Advisors, and public input in jointly determining the annual quota and framework adjustments.

4. The Bluefish Management Board makes final decisions on the quota and framework adjustments for state waters, establishing compliance criteria and dates.

5. The Coastal Migratory Committee makes recommendations to the Council.

6. The Council considers the recommendations of the Coastal Migratory Committee and make their recommendations to the Regional Administrator.

7. The Regional Administrator considers the recommendations of the Council and the Commission Bluefish Management Board's decision and publishes proposed measures in the *Federal Register*.

3.1.1.7 Framework Adjustment Process

In addition to the annual review and modifications to management measures detailed in section 3.1.1.6, the Council could add or modify management measures through a framework adjustment procedure. This adjustment procedure allows the Council to add or modify management measures through a streamlined public review process. As such, management measures that have been identified in the plan could be implemented or adjusted at any time during the year. The Commission could implement these same modifications through their adaptive management process (see section 5.1.4.1.3).

The following management measures could be implemented or modified through framework adjustment procedures:

1. Minimum fish size.
2. Maximum fish size.
3. Gear restrictions (e.g., mesh size).
4. Gear requirements or prohibitions.
5. Permitting restrictions.
6. Recreational possession limit.
7. Recreational season.
8. Closed areas.
9. Commercial season.
10. Description and identification of essential fish habitat and habitat areas of particular concern.
11. Any other management measures currently included in the FMP.

The adjustment procedure would involve the following steps. If the Council determines that an addition or adjustment to management measures is necessary to meet the goals and objectives of the Bluefish FMP, it will recommend, develop and analyze appropriate management actions over the span of at least two Council meetings. The Council will provide the public with advance notice of the availability of the recommendation, the appropriate justifications and economic and biological analyses, and opportunity to comment on the proposed adjustments at the first Council meeting and prior to and at the second Council meeting. After developing management actions and receiving public testimony, the Council will then submit the recommendation to the Regional Administrator. The Council's recommendation to the Regional Administrator must include supporting rationale, an analysis of impacts, and a recommendation to the Regional Administrator on whether to publish the management measures as a final rule.

If the Council recommends that the management measures should be published as a final rule, the Council must consider at least the following factors and provide support and analysis for each factor considered:

1. Whether the availability of data on which the recommended management measures are based allows for adequate time to publish a proposed rule.

2. Whether regulations have to be in place for an entire harvest/fishing season.

3. Whether there has been adequate notice and opportunity for participation by the public and members of the affected industry in the development of the Council's recommended management measures.

4. Whether there is an immediate need to protect the resource.

5. Whether there will be a continuing evaluation of management measures adopted following their promulgation as a final rule.

If, after reviewing the Council's recommendation and supporting information:

1. The Regional Administrator concurs with the Council's recommended management measures and determines that the recommended management measures may be published as a final rule then the action will be published in the Federal Register as a final rule; or

2. The Regional Administrator concurs with the Council's recommendation and determines that the recommended measures should be published first as a proposed rule, the action will be published as a proposed rule in the Federal Register. After additional public comment, if the Regional Administrator concurs with the Council recommendation, the action will be published as a final rule in the Federal Register; or

3. The Regional Administrator does not concur, the Council will be notified, in writing, of the reason for non-concurrence.

3.1.1.8 Commercial management measures

3.1.1.8.1 Commercial quota

The process used to set the quota is specified in 3.1.1.6. A quota would be allocated to the commercial fishery to control fishing mortality. The quota would be based on projected stock size estimates for that year as derived from the latest stock assessment information. Estimates of stock size coupled with the target fishing mortality rate would allow for a calculation of total allowable landings (TAL). Based on the historic proportion of commercial and recreational landings for the period 1981-1989, 17% of the total allowable landings would be allocated to the commercial fishery (Table 23). If 17% of the TAL was less than 10.5 million lbs (4763 mt), then the quota could be increased up to 10.5 million pounds if the recreational fishery was projected to land less than 83% of the TAL for the upcoming year.

Under this alternative, recreational landings from the prior year would be compared to the proposed recreational harvest limit. If, based on this comparison, the recreational fishery was not anticipated to land their limit, the commercial quota could be increased from the level associated with 17% of the TAL up to 10.50 million lbs (4,763 mt). This amount is the average commercial landings for the period 1990-1997. The Council and Commission recommended a quota of 9.586 million lbs for 1999.

A state-by-state system to distribute and manage the annual commercial quota would be implemented by the Council and Commission. Quotas would be distributed to the states based on their percentage share of commercial landings for the period 1981-1989. These state specific shares are specified in Table 48. States would be expected to adopt appropriate measures to prevent quota overages and to indicate these measures in their annual report to the Commission Management Board. States would have the responsibility for closures in their state and the Regional Administrator would be required to prohibit landings by federally permitted individuals in any state that had reached its quota. States would be allowed to trade or combine quotas, and the states could impose trip limits or other measures to manage their quotas. The system would be the same as that operating under the Summer Flounder FMP.

The state shares could be revised based on the recommendations of the Commission to account for any changes in the landings data for the base years 1981-1989. Individuals or vessels with commercial permits could not land bluefish in any state that had not been allocated a commercial quota.

The annual commercial quota will be set at a range of between 0 and the commercial share of the maximum allowed by the adopted fishing mortality rate reduction strategy. The commercial quota includes all landings for sale by *any* gear. If a person or vessel does not have a commercial bluefish permit, the fish may not be sold and the recreational rules on size, possession, and season apply.

The annual commercial quota would be based on the recommendations of the Bluefish FMP Monitoring Committee to the Council and Commission Board. The commercial quota may change annually, if appropriate, following the Bluefish Monitoring Committee process set forth in 3.1.1.6.

The quota could be applied throughout the management unit, that is, in both state and federal waters. All bluefish landed for sale in a state would be applied against the state's annual commercial quota regardless of where the bluefish were harvested. Any overages of the commercial quota landed in a state would be deducted from that state's annual quota for the following year.

Using data collected through this FMP (section 3.1.1.11), NMFS will monitor the fishery to determine when a quota will be reached. The Commission has established compliance criteria as a part of the interstate management process (see section 5.1.4.1). These compliance criteria would require states to submit dealer reports to NMFS for state permitted dealers.

The Regional Administrator shall close the EEZ to commercial fishing for bluefish when the quota has been landed. Each state shall close its waters to commercial fishing for bluefish when its share of the quota is landed.

3.1.1.8.2 Commercial minimum fish size

A minimum fish size may be implemented, if appropriate, following the Bluefish FMP Monitoring Committee process (3.1.1.6) or the framework adjustment process (3.1.1.7). It would also be illegal to possess parts of bluefish less than the minimum size to the point of landing. If bluefish are filleted at sea, the skin would be required to be left on the fillet for purposes of identification.

Individuals with commercial bluefish permits issued pursuant to this FMP would be required to fish and land pursuant to the provisions of this FMP unless the individual lands bluefish in states with larger minimum fish sizes than those provided in the FMP, in which case the minimum fish size would be required to meet the state limits. States with minimum size larger than those in the FMP would be encouraged to maintain them.

3.1.1.8.3 Minimum mesh requirement

Minimum mesh restrictions for otter trawls and gill nets may be implemented according to the framework process specified in section 3.1.1.6 or 3.1.1.7. Mesh would be allowed to be larger than the minimum size, but it could be no smaller than the minimum size. If the fish are landed in a state that has a more stringent net mesh regulation, the state regulation would prevail.

3.1.1.8.4 *De minimus* specifications

The Commission Interstate Fisheries Management Program Charter (Charter) defines *de minimus* as a situation in which, under existing conditions of the stock and scope of the fishery, conservation and enforcement actions taken by an individual state would be expected to contribute insignificantly to a coastwide conservation program required by an FMP or amendment.

Any state that has commercial landings less than 0.1% of the total coastwide commercial landings in the last preceding year for which data are available is eligible for *de minimus*. The *de minimus* specifications only apply to the commercial fishery. There are no recreational *de minimus* allowances for the bluefish recreational fishery.

Any state granted *de minimus* status will be allocated 0.1% of the coastwide commercial quota. The sum of the allocations to *de minimus* states will be deducted from the coastwide commercial quota before the remainder is allocated to the other states.

States must specifically request *de minimus* status each year, and requests for *de minimus* status will be reviewed by the Technical Monitoring Committee as part of the annual FMP review process. Recommendations from the Committee will follow the procedures outlined in section 3.1.1.6. The committee will consider the most recent available data, as well as projections of future landings, in determining whether or not a state meets the *de minimus* requirements. They will also consider the intended regulatory program of the state to ensure that the state is taking reasonable steps to prevent a sudden and unexpected increase in landings. The Technical Committee will make a recommendation to the Coastal Migratory Species Committee and the Bluefish Management Board to either accept or deny the *de minimus* request. The Coastal Migratory Committee will then make a recommendation to the Council which will then make a recommendation to the Regional Administrator. The Management Board will review the Technical Monitoring committee and Coastal Migratory Committee recommendations and will grant or deny the *de minimus* classification, the Regional Administrator will review the Coastal Migratory Committee recommendation and the Bluefish Management Board must make a specific motion to grant a state *de minimus* status. By deeming a given state *de minimus*, the Regional Administrator and Management Board are recognizing that the state has a minimal commercial bluefish fishery, that there is no risk to the health of the bluefish stock if the state does not implement the full suite of management measures, and that the overall burden of implementing the complete commercial management and monitoring requirements of the FMP outweigh the conservation benefits of implementing those measures in the particular state.

If *de minimus* status is granted, the *de minimus* state is required to implement the minimum size of possession for the commercial fishery, all permitting and reporting requirements, all gear restrictions, and must monitor its fishery. A *de minimus* state would be required to report landings annually. The Regional Administrator will close a states fishery if the *de minimus* allocation is landed. If commercial landings in the state exceed the *de minimus* threshold, the state will lose its *de minimus* classification and will be required to implement all the commercial fishery requirements of the FMP. If the Regional Administrator and/or Management Board deny a state's *de minimus* request, the state will be required to implement all the commercial fishery requirements of the FMP. When a state is denied or loses its *de minimus* status, the Regional Administrator and the Management Board will set a compliance date by which the state must implement the required regulations.

3.1.1.9 Recreational management measures

3.1.1.9.1 Recreational harvest limit

A recreational harvest limit would be allocated to the recreational fishery to reduce exploitation rates. The harvest limit would be based on projected stock size estimates for that year as derived from the latest stock assessment information. Estimates of stock size coupled with the target fishing mortality rate would allow for a calculation of total allowable landings. Based on the historic proportion of commercial and recreational landings from 1981-1989, 83% of the total allowable landings would be allocated to the recreational fishery (Table 23). The annual recreational harvest limit will be set at a range of between 0 and the maximum allowed by the recreational share of the annual quota. The Council and Commission recommended a 25.434 million lbs recreational harvest limit for 1999.

3.1.1.9.2 Recreational size, possession, and seasonal limits

The current 10 fish possession limit would remain in effect. A minimum fish size may be implemented, if appropriate, following the Bluefish FMP Monitoring Committee process (3.1.1.6) or the framework adjustment process (3.1.1.7). Parts of bluefish could be less than the minimum size if the party/charter vessel had a permit from the state of landing that allowed smaller parts to be landed. If bluefish are filleted at sea, the skin would be required to be left on the fillet for purposes of identification.

States could develop and implement alternative recreational management measures that were equivalent to the coastwide measures. The effects of a 10 fish possession limit would be determined and compared to an alternative that included possession and seasonal limits to determine equivalency. The process used to determine equivalency is detailed in section 5.1.4.1.3 of this amendment.

The recreational fishery throughout the management unit would be managed through an annual evaluation of a framework system (section 3.1.1.6) of possession limits, size limits, and seasonal closures. Recreational management measures could also be modified as a result of the framework adjustment process specified in section 3.1.1.7. Recreational landings would be compared to annual target harvest levels established through the FMP Monitoring Committee process to determine if modifications to the recreational possession limit and size limit were required for the following year or if the fishery needed to be closed for certain periods.

The annual recreational possession limit, size limit, and season will be set at a range of between 0 and the maximum allowed by the recreational share of the adopted fishing mortality rate reduction strategy.

On vessels with several passengers, where catches are pooled in one or more containers, the number of bluefish contained on the vessel may not exceed the possession limit multiplied by the number of people aboard the vessel.

3.1.1.10 Other measures

Only persons with a dealer permit may buy bluefish at the point of first sale landed by an individual that has a commercial bluefish permit issued pursuant to this FMP. Only persons with a dealer permit may buy bluefish landed by a vessel or individual that has a commercial permit issued pursuant to this FMP.

Individuals and owner/operators with commercial permits may sell bluefish at the point of first sale only to a dealer that has a dealer permit issued pursuant to this FMP.

The amount of bluefish on board a vessel using mesh sizes smaller than those specified for trawl or gill net gear may not exceed the minimum threshold as specified.

All bluefish on vessels fishing with a mesh smaller than the legal minimum size must have any bluefish on board boxed in a manner that will facilitate enforcement personnel knowing whether the vessel has more than the level specified of bluefish on board to meet the minimum mesh size criterion. Any unboxed bluefish on board a vessel fishing with a net smaller that the legal minimum is considered a violation of this FMP. A box holds 100 lbs of bluefish and is approximately 36" long, 15" wide, and 12" high (approximately 3.75 cubic feet).

The Regional Administrator may place sea samplers aboard vessels if he determines a voluntary sea sampling system is not giving a representative sample from the bluefish fishery.

No foreign fishing vessel shall conduct a fishery for or retain any bluefish. Foreign nations catching bluefish shall be subject to the incidental catch regulations set forth in 50 CFR 611.13, 611.14, and 611.50.

3.1.1.11 Specification and sources of pertinent fishery data

3.1.1.11.1 Domestic and foreign fisheries

Section 303(a)(5) of the MSFCMA requires that Council specify the pertinent data which shall be submitted to the Secretary with respect to commercial, recreational, and charter/party fishing in the fishery, including but not limited to, information regarding the type and quantity of fishing gear used, catch by species in numbers of fish or weight thereof, areas in which fishing was engaged in, time of fishing, number of hauls and the estimated processing capacity of, and actual processing capacity utilized by United States fish processors. In order to achieve the objectives of this FMP and to manage the fishery for the maximum benefit of the U.S., it is necessary that, at a minimum, the Secretary collect on a continuing basis and make available to the Councils: (1) bluefish catch, effort, and exvessel value and the catch and exvessel value of those species caught in conjunction with bluefish for the commercial fishery provided in a form that analysis can be performed at the trip, water area, gear, month, year, principal (normal) landing port, landing port for trip, and state levels of aggregation; (2) catch, effort and discards for the recreational fishery; (3) biological (e.g., length, weight, age, and sex) samples from both the commercial and recreational fisheries; and (4) annual and fully comparable NMFS bottom trawl surveys for analyses of both CPUE and age/size frequency. The Secretary may implement necessary data collection procedures through amendments to the regulations. It is mandatory that these data be collected for the entire management unit on a compatible and comparable basis.

Commercial logbooks must be submitted on a monthly basis by federal commercial permit holders in order to monitor the fishery.

Operators of party and charter boat with federal permits issued pursuant to this FMP must submit logbooks monthly showing at least: name and permit number of the vessel; total amount in pounds and numbers of each species taken; date(s) fished; number of trips; duration of trip; locality fished; crew size; landing port; number of anglers carried on each trip; and discard rate.

As part of the interstate management process, compliance criteria will be established to require states to implement equivalent fishery data collection systems for the development of a coordinated statistics gathering effort (section 5.1.4.1). States would be required to report all landings, including those from state waters and by state permitted vessels or fishermen.

It is intended that the reports required by this section are the same as the reports required by the Summer Flounder FMP, the Northeast Multispecies FMP, and the Atlantic Sea Scallop FMP. That is, fishermen need to submit one logbook report, not one report for each FMP.

Foreign fishermen are subject to the reporting and recordkeeping requirements in 50 CFR 611.

3.1.1.11.2 Dealers

In order to monitor the fishery and enable the Regional Administrator and the states to forecast when a closure will be needed, dealers with permits issued pursuant to this FMP must submit weekly reports showing at least the quantity of bluefish purchased (in pounds) and the name and permit number of the individuals from whom the bluefish was purchased. Dealers having state permits are required to report to the state or NMFS all bluefish purchased. States would report state landings weekly to NMFS.

Buyers that do not purchase directly from vessels are not required to submit reports under this provision. Dealers should report only those purchases from fishermen or vessels with commercial permits to sell bluefish.

3.1.1.11.3 Processors

Section 303(a)(5) of the MSFCMA requires that at least estimated processing capacity of, and the actual processing capacity utilized by U.S. fish processors, must be submitted to the Secretary. The Secretary may implement necessary data collection procedures through amendments to the regulations.

3.1.2 Alternatives to the Preferred Management Measures

3.1.2.1 Take no action at this time

This would mean that the current regulations would remain unchanged.

3.1.2.2 Allocate the annual quota between the recreational and commercial fisheries based on landings for the period 1981-1989

The bluefish fishery would be managed via a quota setting process specified in 3.1.1.6. Under this alternative, the annual quota would be allocated to the commercial and recreational sectors of the fishery based on their respective percentages on landings for the period 1981-1989 (Table 23). This non-preferred alternative is identical to the commercial quota (3.1.1.8.1) and recreational harvest limit alternatives (3.1.1.9.1) with the exception that under this non-preferred alternative, the commercial quota could not increase above the amount associated with the 17% allocation.

3.1.2.3 Allocate the annual quota between the recreational and commercial fisheries based on landings for the period 1981-1993

The bluefish fishery would be managed via a quota setting process specified in 3.1.1.6. Under this alternative, the annual quota would be allocated to the commercial and recreational sectors of the fishery based on their respective percentages on landings for the period 1981-1993 (Table 23).

3.1.2.4 Allocate the annual quota between the recreational and commercial fisheries based on landings for the period 1985-1989

The bluefish fishery would be managed via a quota setting process specified in 3.1.1.6. Under this alternative, the annual quota would be allocated to the commercial and recreational sectors of the fishery based on their respective percentages on landings for the period 1985-1989 (Table 23).

3.1.2.5 Implement a state-by-state commercial quota system with allocations based on landings from 1981-1993

The quota setting process is specified in 3.1.1.6. Quotas would be distributed to the states based on their percentage share of commercial landings for the period 1981-1993. These state specific shares are specified in Table 49.

3.1.2.6 Implement a state-by-state commercial quota system with allocations based on landings from 1985-1989

The quota setting process is specified in 3.1.1.6. Quotas would be distributed to the states based on their percentage share of commercial landings for the period 1985-1989. These state specific shares are specified in Table 50.

3.1.2.7 Implement a coastwide trip limit system in conjunction with a state by state quota system

This alternative would establish a system of uniform trip limits established on a coastwide basis in conjunction with the state by state quota system. Commercial quotas would be allocated to the states as detailed in the preferred alternative.

3.1.2.8 Commercial maximum fish size limit

It would be illegal for individuals who possess commercial bluefish permits to possess bluefish larger than a specified size limit. If bluefish are filleted at sea, the skin would be required to be left on the fillet for purposes of identification.

3.1.2.9 Quarterly coastwide commercial quota with coastwide trip limits

A quarterly coastwide quota will be allocated to the commercial fishery to reduce exploitation rates on the fully recruited age groups. The quota will be based on projected stock size estimates for that year as derived from the latest stock assessment information. Estimates of stock size coupled with the target fishing mortality rate will allow for a calculation of total allowable landings. Based on 1981-1989 data on commercial and recreational landings, 17% of the total allowable landings will be allocated to the commercial fishery as the commercial quota.

Quarterly allocations will be based on commercial landings data from 1981-1989. The allocation periods and the associated percent of the total quota will be: January-March (46.65%), April-June (20.52%), July-September (10.19%), and October-December (22.64%).

Trip limits will be implemented for each quarterly period. The trip limit will remain the same throughout the period. Trip limits will remain in effect until the fishery is closed by NMFS based on projections that the quota would be taken.

Any landings in excess of the quota that occurred during a quarter will be subtracted from the following year's quota for that quarter. For example, if the quota was exceeded by 10,000 lbs in the first quarter of 1999, 10,000 lbs would be subtracted from the quota for that quarter in 2000.

All landings by any vessel that has a commercial moratorium permit (permit to sell) will count against the quota, whether the bluefish are caught with an otter trawl, fish pot, hook and line, or any other gear. If the vessel does not have a commercial moratorium permit, fish caught in the EEZ cannot be sold and the recreational rules on size, possession, and season apply.

Using data collected through this FMP (section 3.1.1.11), NMFS will monitor the fishery to determine when a quota will be reached. It is intended that the states will assist NMFS with data collection. The coastal states would work with NMFS to administer the quotas and coordinate coastwide closures.

If the quarterly quota has been met, landings of bluefish by all vessels will be prohibited. The Regional Administrator will close the EEZ to possession of bluefish by commercial vessels with a moratorium permit when the quota has been landed. States will have the responsibility for closure in their state.

The annual commercial quota will be set at a range of between 0 and the commercial share of the maximum allowed by the adopted fishing mortality rate reduction strategy. The annual commercial quota and trip limits would be based on the recommendations of the Bluefish FMP Monitoring Committee to the Council and ASMFC Board. The Council and ASMFC will consider those recommendations and submit their recommendations to the Regional Administrator. The Regional Administrator will set the commercial quota and trip limits annually.

3.1.2.10 Licensing individuals in the commercial and party/charter fisheries

Under this alternative, any person selling a bluefish would be identified as a commercial fisherman and must have a commercial fishing permit that allows the sale of bluefish (i.e., the individual is licensed). This commercial definition would include, among others, all hook and line fishermen who sell bluefish, regardless of fishing mode (that is, fishing from shore, man-made structures, private boats, party boats, or charter boats). Either a federal individual permit or state commercial permit would be required to sell bluefish. Those without a federal permit are required to have a state permit.

The federal costs of implementing an annual permit system for the sale of bluefish shall be charged to permit holders as authorized by section 303(b) (1) of the Magnuson-Stevens Act. In establishing the annual fee, the NMFS Regional Administrator will ensure that the fee does not exceed the administrative costs incurred in issuing the permit, as required by section 304(d) of the Magnuson-Stevens Act.

A recreational vessel, other than a party or charter boat (vessel for hire), is exempt from the permitting requirement if it catches no more than the recreational possession limit, multiplied by the number of persons on board, of bluefish per trip.

Under this alternative, any person fishing from a party or charter boat carrying passengers for hire may have an individual license to sell bluefish and is then not subject to the recreational possession limit. These individuals must keep their catch separate from the other individuals. When a party or charter boat is operating as a commercial vessel (not carrying passengers for hire), the crew size must not exceed 5 for a party boat and not more than 3 for a charter boat.

3.1.2.11 Alternative rebuilding schedules

3.1.2.11.1 Reduction in fishing mortality by 75% over a five year period (1999 to 2003) to rebuild to biomass target (B_{MSY})

The Sustainable Fisheries Act (SFA) requires the Council to set the overfishing definition to meet a new standard (F_{MSY}). In addition, the resource must be rebuilt to B_{MSY} in as short a period as possible. The rebuilding period is not to exceed 10 years, except where biology, environmental conditions, or international agreements dictate otherwise.

In an update to the most recent assessment for bluefish, Gibson and Lazar (1998a) found that current fishing mortality for bluefish exceeds the threshold fishing mortality rate (F_{MSY}). In addition, total stock biomass of bluefish is currently 23% of the target biomass (B_{MSY}). Thus, the Atlantic coast bluefish stock is considered overfished according to the new SFA overfishing guidelines and requires rebuilding. This amendment address the overfishing problem and plans to rebuild the resource to meet SFA requirements over a five year planning horizon.

This alternative rebuilding schedule is a graduated reduction in fishing mortality of 75% over a five year period (1999 to 2003) to rebuild the biomass target (B_{MSY}). This recovery schedule will eliminate overfishing according to the newly revised overfishing definition. It will also allow for rebuilding of the bluefish stock to a level that could produce MSY on a continuing basis in 5 years. The recovery schedule associated with this alternative is displayed in Table 51.

Under this management alternative, the TAC for 1999 would be 30.42 million lbs (13,800 mt) (Table 51). The projected yields include commercial landings and recreational catch. As such, an estimate of recreational discards must be subtracted from the TAC to derive a TAL. Discards would be estimated for each year and subtracted from the annual TAC to derive the TAL for that year. For 1999, an estimated 1.82 million lbs (825 mt) of discards are deducted from the TAC to yield a TAL of 28.60 million lbs (12,975 mt) (Table 47). This discard level (825 mt) is equal to the average recreational discards for the period 1993 to 1996.

3.1.2.11.2 Constant harvest strategy throughout the entire recovery period until the stock is recovered

The Sustainable Fisheries Act (SFA) requires the Council to set the overfishing definition to meet a new standard (F_{MSY}). In addition, the resource must be rebuilt to B_{MSY} in as short a period as possible. The rebuilding period is not to exceed 10 years, except where biology, environmental conditions, or international agreements dictate otherwise.

In an update to the most recent assessment for bluefish, Gibson and Lazar (1998a) found that current fishing mortality for bluefish exceeds the threshold fishing mortality rate (F_{MSY}). In addition, total stock biomass of bluefish is currently 23% of the target biomass (B_{MSY}). Thus, the Atlantic coast bluefish stock is considered overfished according to the new SFA overfishing guidelines and requires rebuilding. This amendment address the overfishing problem and plans to rebuild the resource to meet SFA requirements over a six year planning horizon.

Under this alternative rebuilding schedule, the harvest level is held constant throughout the entire recovery period (1999 to 2004) to rebuild the biomass target (B_{MSY}). This recovery schedule will eliminate overfishing according to the newly revised overfishing definition. It will also allow for rebuilding of the bluefish stock to a level that could produce MSY on a continuing basis in approximately 6 years. The recovery schedule associated with this alternative is displayed in Table 52.

Under this management alternative the TAC for years 1999-2003 would be held constant at 32 million lbs (14,515 mt) (Table 52). The projected yields include commercial landings and recreational catch. As such, an estimate of recreational discards must be subtracted from the TAC to derive a TAL. Discards would be estimated for each year and subtracted from the annual TAC to derive the TAL for that year. For 1999, an estimated 1.82 million lbs (825 mt) of discards are deducted from the TAC to yield a TAL of 30.18 million lbs (13,690 mt) (Table 47). This discard level (825 mt) is equal to the average recreational discards for the period 1993 to 1996.

3.1.2.11.3 Constant fishing mortality (F=0.23) over a five year period (1999 to 2003) to rebuild to biomass target (B_{MSY})

The Sustainable Fisheries Act (SFA) requires the Council to set the overfishing definition to meet a new standard (F_{MSY}). In addition, the resource must be rebuilt to B_{MSY} in as short a period as possible. The rebuilding period is not to exceed 10 years, except where biology, environmental conditions, or international agreements dictate otherwise.

In an update to the most recent assessment for bluefish, Gibson and Lazar (1998a) found that current fishing mortality for bluefish exceeds the threshold fishing mortality rate (F_{MSY}). In addition, total stock biomass of bluefish is currently 23% of the target biomass (B_{MSY}). Thus, the Atlantic coast bluefish stock is considered overfished according to the new SFA overfishing guidelines and requires rebuilding. This amendment address the overfishing problem and plans to rebuild the resource to meet SFA requirements over a five year planning horizon.

In this alternative rebuilding schedule, the fishing mortality is held constant throughout the entire recovery period (1999 to 2003) to rebuild the biomass target (B_{MSY}). This recovery schedule will eliminate overfishing according to the newly revised overfishing definition. It will also allow for rebuilding of the bluefish stock to a level that could produce MSY on a continuing basis in 5 years. The recovery schedule associated with this alternative is displayed in Table 53.

Under this management alternative, the TAC for 1999 would be 19.15 million lbs (8,686 mt) (Table 53). The projected yields include commercial landings and recreational catch. As such, an estimate of recreational discards must be subtracted from the TAC to derive a TAL. Discards would be estimated for each year and subtracted from the annual TAC to derive the TAL for that year. For 1999, an estimated 1.82 million lbs (825 mt) of discards are deducted from the TAC to yield a TAL 17.33 million lbs (7,861 mt) (Table 47). This discard level (825 mt) is equal to the average recreational discards for the period 1993 to 1996.

3.1.2.11.4 Constant fishing mortality (F=0.36) over a nine year period (1999 to 2007) to rebuild to biomass target (B_{MSY})

The Sustainable Fisheries Act (SFA) requires the Council to set the overfishing definition to meet a new standard (F_{MSY}). In addition, the resource must be rebuilt to B_{MSY} in as short a period as possible. The rebuilding period is not to exceed 10 years, except where biology, environmental conditions, or international agreements dictate otherwise.

In an update to the most recent assessment for bluefish, Gibson and Lazar (1998a) found that current fishing mortality for bluefish exceeds the threshold fishing mortality rate (F_{MSY}). In addition, total stock biomass of bluefish is currently 23% of the target biomass (B_{MSY}). Thus, the Atlantic coast bluefish stock is considered overfished according to the new SFA overfishing guidelines and requires rebuilding. This amendment address the overfishing problem and plans to rebuild the resource to meet SFA requirements over a nine year planning horizon.

In this alternative rebuilding schedule, the fishing mortality is held constant throughout the entire recovery period (1999 to 2007) to rebuild the biomass target (B_{MSY}). This recovery schedule will eliminate overfishing according to the newly revised overfishing definition. It will also allow for rebuilding of the bluefish stock to a level that could produce MSY on a continuing basis in 5 years. The recovery schedule associated with this alternative is displayed in Table 54.

Under this management alternative, the TAC for 1999 would be 27.87 million lbs (12,640 mt) (Table 54). The projected yields include commercial landings and recreational catch. As such, an estimate of recreational discards must be subtracted from the TAC to derive a TAL. Discards would be estimated for each year and subtracted from the annual TAC to derive the TAL for that year. For 1999, an estimated 1.82 million lbs (825 mt) of discards are deducted from the TAC to yield a TAL 26.05 million lbs (11,815 mt) (Table 47). This discard level (825 mt) is equal to the average recreational discards for the period 1993 to 1996.

3.1.3 The Amendment Relative to the National Standards

Section 301(a) of the MSFCMA states: "Any fishery management plan prepared, and any regulation promulgated to implement such plan pursuant to this title shall be consistent with the following national standards for fishery conservation and management." The following is a discussion of the standards and how this amendment meets them.

3.1.3.1 Conservation and management measures shall prevent overfishing while achieving, on a continuous basis, the optimum yield from each fishery for the United States fishing industry.

The Sustainable Fisheries Act (SFA), which reauthorized and amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) made a number of changes to the existing National Standards. With respect to National Standard 1, the SFA imposed new requirements concerning definitions of overfishing in U.S. fishery management plans. To comply with National Standard 1, the SFA requires that each Council FMP define overfishing as a rate or level of fishing mortality that jeopardizes a fisheries capacity to produce maximum sustainable yield (MSY) on a continuing basis.

The SFA also requires that each FMP specify objective and measurable status determination criteria for identifying when stocks or stock complexes covered by the FMP are overfished. To fulfill the requirements of the SFA, status determination criteria for bluefish are comprised of two components: 1) a maximum fishing mortality threshold and 2) a minimum stock size threshold. The maximum F threshold is specified as F_{MSY}. The minimum biomass threshold is specified as ½ B_{MSY}.

For bluefish, maximum sustained yield (MSY) and the biomass that produces MSY in the long-term (B_{MSY}) were most recently estimated by Gibson and Lazar (1998a) using the ASPIC surplus production model. F_{MSY} was estimated to be 0.4 and B_{MSY} was estimated to be 107,500 mt (237 million lbs). These values form the basis of the definition of overfishing for bluefish. The maximum fishing mortality rate is defined as $F_{MSY}=0.4$ and the minimum stock biomass is defined as ½ B_{MSY} or 118.5 million lbs (53,750 mt).

In summary, the recommended biological reference points that would define overfishing and overfished conditions for bluefish are as follows:

Reference point	Basis	Estimated value
Biomass target	B_{MSY} (the spawning stock biomass estimated to produce maximum sustainable yield)	237 million lbs total stock biomass
Biomass threshold	½ B_{MSY}	118.5 million lbs (53,750 mt) total stock biomass
Current stock biomass - 1997	ASPIC surplus production model	54.51 million lbs (23% of the biomass target)
Fishing mortality target	Fishing mortality rate equal to 90% of F_{MSY}	0.36
Fishing mortality threshold	The fishing mortality rate that produces maximum sustainable yield (F_{MSY})	0.4 (78% of current fishing mortality)
Current fishing mortality (most recent estimate was for 1997)	ASPIC surplus production model	0.51

3.1.3.2 Conservation and management measures shall be based upon the best scientific information available.

This amendment is based on the best and most recent scientific information available. Future bluefish research should be devoted toward both data collection and analysis in order to evaluate the effectiveness of this FMP. This species should be reviewed annually by the NEFSC Stock Assessment Workshop process.

3.1.3.3 To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

The FMP's management unit is bluefish throughout their range on the Atlantic coast from Maine through Florida, including the EEZ, territorial sea, and internal waters. This specification is consistent with National Standard 3.

3.1.3.4 Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

The amendment does not discriminate among residents of different states. It does not differentiate among U.S. citizens, nationals, resident aliens, or corporations on the basis of their state of residence. It does not incorporate or rely on a state statute or regulation that discriminates against residents of another state.

In choosing historical catch as a basis of allocation, and by virtue of acceptance by the states of the time frame and the resulting percent of allocations, National Standard 4A, the "fair and equitable to all such fishermen" test, has been met. In addition, this amendment would allow for the state shares associated with the allocation to be revised based on the recommendations of the Commission to account for any changes in the landings data for the base years 1981-1989.

Since the quota is based on stock size and will be determined annually to assure that the target mortality rate is not exceeded, National Standard 4B is met. In order to assure that 4C is fully met, any state or states not in compliance with the quota, that is, those states which exceed the allocated amount, must be prevented from taking additional bluefish or an excessive share will be realized by the residents of that state, unfairly penalizing the other participants in the fishery. This obligation is met since the Regional Administrator can close a state to further landings of bluefish by federal permit holders once a quota is reached, and in addition, the Commission requires, as part of their interstate management process, that states have the ability to close when their commercial quota is reached.

In the commercial fishery, the minimum fish size and minimum net mesh size will be applied coastwide. In addition, the recreational measures are applied coastwide. These provisions are, therefore, "fair and equitable to all fishermen."

The recreational size limit, possession limit, and season are all specified so they may be adjusted annually following procedures set forth in the amendment to assure that the fishing mortality target is achieved. The commercial quota, minimum fish size, and minimum net mesh provision are also specified so they may be adjusted annually following procedures set forth in the FMP to assure that the fishing mortality target is achieved. These provisions are, therefore, "reasonably calculated to promote conservation."

3.1.3.5 Conservation and management measures shall, where practicable, consider efficiency in the utilization of the fishery resources; except that no such measure shall have economic allocation as its sole purpose.

The management regime is intended to allow the fishery to operate at the lowest possible cost (e.g., fishing effort, administration, and enforcement) given the amendment's objectives. The objectives focus on the issue of administrative and enforcement costs by encouraging compatibility between federal and state regulations since a substantial portion of the fishery occurs in state waters. The amendment places no restrictions on processing or marketing.

3.1.3.6 Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

The management regime was developed to be compatible with and reinforce the management efforts of the states and Commission. The amendment allows the states to manage their commercial quotas, the only constraint being a review to assure that the state's management system will not allow the quota to be exceeded.

The commercial minimum fish size, gear regulations, and commercial quota and the recreational size limits, possession limits, and season are all specified so that they may be adjusted annually following procedures set forth in the amendment to assure that the fishing mortality reductions strategy is followed. In addition, states may impose alternative size, possession, and seasonal limits as long as they are determined to be equivalent to the conservation measures recommended by the plan.

3.1.3.7 Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

The management regime was developed to be compatible with and reinforce the management efforts of the states and Commission. The minimum size limits, quotas, possession limits, and, to some extent, closed seasons, can be enforced on shore, thus eliminating the need for high cost at sea enforcement. The provisions of this amendment have been adopted by the Commission.

3.1.3.8 Conservation and management measures shall, consistent with the conservation requirements of the Magnuson-Stevens Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

The Sustainable Fisheries Act (SFA), which reauthorized and amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) made a number of changes to the existing National Standards, as well as to definitions and other provisions an the Magnuson-Stevens Act. In regard to National Standard 8, the SFA requires that the importance of the fishery resources to fishing communities must be taken into account when implementing conservation and management measures.

The socio-economic characteristics of the various ports and communities along the Atlantic coast that depend on the bluefish fisheries were described and assessed by McCay *et al.* (1993). These ports and communities are described in section 2.3.4. According to the 1992 landings statistics, bluefish is of minor importance to the commercial industry in many of the ports that were analyzed. Only North Carolina reported any reliance on bluefish. For example, McCay *et al.* (1993) reported that summer flounder (21%) were the most important species in Dare County in terms of landed value in 1991. The value of all species landed in Dare County was over $11 million in 1991. Blue crabs (hard) are second in importance (11%), followed by weakfish (9%). Other species of interest landed in Dare County in 1991 were bluefish (4.02%), sea basses (3.41%), dogfish (1.00%), tilefish (0.53%), scup (0.41%), butterfish (0.31%), squid (0.29%), and Atlantic mackerel (0.12%). According to Griffith (1996), few full-time, owner-operator fishermen in North Carolina rely on a single species or single gear for their livelihood. Most of them are flexible and can target various species with more than one gear type.

Although overall there is little port reliance on bluefish commercially, it can be expected that the proposed regulatory measure will have a positive long-term impact on the communities and local economies of these ports. The proposed amendment will reduce the chance that the bluefish fishery will be overfished. This will provide positive benefits to the ports and communities who depend in part on bluefish for employment and income.

Bluefish are very important to the recreational fisheries of the Atlantic coast of the U.S. For example, during the period 1981-96, bluefish accounted for 29% of the Atlantic coast recreational harvest of finfish by weight (the highest of any species), ranging from 42% in 1981 to 11% in 1995. The number of participants in the marine recreational fisheries of the Atlantic coast has remained relatively constant in the last decade and a half (e.g., 4.6 million in 1981 versus 4.8 million in 1996). However, the number of trips made during the same time period ranged from 28.3 million in 1981 to 40.1 million trips in 1996 (MRFSS unpublished data).

During the 1980's, a significant portion of these participants and trips depended upon bluefish, particularly those in the Mid-Atlantic region from the party-charter mode. For example, in 1985 party/charter boats in the Mid-Atlantic region landed a total of 22.2 million lbs of fish, over half of which were bluefish (12.3 million lbs). Further evidence of the reliance of the party/charter sector was provided by a survey of party/charter boats from the region (Maine to Virginia) conducted by the Mid-Atlantic Council in 1990. The Council conducted a survey of charter and party boat owners from this region in which they were asked to rank each species with respect to interest they had in them and their catch rate success on a scale of 1-5. For party boats, bluefish was the second most desired species and ranked first in the catch reported by party boat owners. For charter boats, bluefish ranked third in terms of desirability and second in terms of success rate. As the abundance of bluefish has declined since then, the contribution of bluefish to the catch from this mode has declined. In 1990 anglers fishing from party/charter boats in the Mid-Atlantic region landed a total of 15.9 million lbs (all species), 23.8% of which were bluefish. By 1995, the contribution of bluefish to the harvest of the Mid-Atlantic party/charter mode declined to 12.4%.

The proper management of the bluefish stock through implementation of the management measures described above will be beneficial to the commercial and recreational fishing communities of the Atlantic coast. By preventing overfishing and allowing stock rebuilding, benefits to the fishing communities will be realized through increased bluefish abundance and subsequent harvests.

3.1.3.9 Conservation and management measures shall, to the extend practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

The Sustainable Fisheries Act (SFA), which reauthorized and amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) made a number of changes to the existing National Standards, as well as to definitions and other provisions an the Magnuson-Stevens Act. In regard to National Standard 9, the SFA requires that bycatch issues must be considered when implementing conservation and management measures.

This national standard requires the Councils to consider the bycatch effects of existing and planned conservation and management measures. Bycatch can, in two ways, impede efforts to protect marine ecosystems and achieve sustainable fisheries and the full benefits they can provide to the Nation. First, bycatch can increase substantially the uncertainty concerning total fishing-related mortality, which makes it more difficult to assess the status of stocks, to set the appropriate optimal yield (OY) and define overfishing levels, and to ensure that OYs are attained and overfishing levels are not exceeded. Second, bycatch may also preclude other more productive uses of fishery resources.

The term "bycatch" means fish that are harvested in a fishery, but that are not sold or kept for personal use. Bycatch includes the discard of whole fish at sea or elsewhere, including economic discards and regulatory discards, and fishing mortality due to an encounter with fishing gear that does not result in capture of fish (i.e., unobserved fishing mortality). Bycatch does not include any fish that legally are retained in a fishery and kept for personal, tribal, or cultural use, or that enter commerce through sale, barter, or trade. Bycatch does not include fish released alive under a recreational catch-and-release fishery management program. A catch-and-release fishery management program is one in which the retention of a particular species is prohibited. In such a program, those fish released alive would not be considered bycatch.

With respect to increased levels of bycatch of bluefish, three of the proposed recreational measures could result in the discard of bluefish which would be kept under current regulations. These measures include the bag limit, size limit, and seasons. Of the three, the bag limit would have the least effect since only about 7% of anglers caught greater than ten fish per person prior to the imposition of possession limits. The effects of the bag limit would be greatest at small bag limits and be progressively less at higher limits. The size limit would have similar effects, but the level of discarding will be dependent upon the levels of incoming recruitment and subsequent abundance of small fish.

The Council believes that information and education programs relative to proper catch and release techniques for bluefish and other species caught by recreational fishermen should help to maximize the number of bluefish released alive. As a result, the mortality of fish released due to the recreational measures for bluefish is expected to be low. In fact, only about 15% of the fish are expected to die after release by anglers.

Minimum size limits, bag limits, and seasons have proven to be effective management tools in controlling fishing mortality in recreational fisheries throughout the world. A notable example is the recent success in the management of the Atlantic coast striped bass fishery. This fishery is similar to the bluefish fishery in that it is predominantly a recreational fishery. The recreational striped bass fishery is managed principally through the use of minimum size limits, bag limits, and seasons. When these measures were first implemented, release rates in the recreational striped bass fishery exceeded 90%. However, the relatively quick and sustained recovery of the striped bass stock after implementation of these measures provides evidence of their effectiveness in controlling fishing mortality in recreational fisheries. These measures also represent the most effective tools to manage the recreational bluefish fishery. The use of these measures are necessary to satisfy National Standard 1 to prevent overfishing. By maximizing the number of fish released alive, the Council has also satisfied National Standard 9 by minimizing bycatch mortality to the extent practicable.

State and federal mesh regulations already in effect for other species (i.e., summer flounder, weakfish, black sea bass, etc.) will reduce the bycatch of small bluefish. In addition, the amendment includes framework provisions to deal with discard problems in the future should they arise. Specifically, if a discard problem is identified, gear restrictions and minimum fish size could be implemented to reduce discard mortality. All of these factors will result in the minimization of bycatch and discard mortality of bluefish in the commercial and recreational fisheries. Therefore, National Standard 9 is satisfied.

3.1.3.10 Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

The Sustainable Fisheries Act (SFA), which reauthorized and amended the Magnuson-Stevens

Fishery Conservation and Management Act (Magnuson-Stevens Act), made a number of changes to the existing National Standards, as well as to definitions and other provisions an the Magnuson-Stevens Act. In regard to National Standard 10, the SFA requires that the safety of human life at sea must be promoted when implementing conservation and management measures.

National Standard 10 recognizes that fishery regulations by definition place constraints on fishing that would not otherwise exist. It's purpose is to ensure that fishery regulations do not create pressures on fishermen to fish under conditions they would otherwise avoid. None of the management measures in this amendment will promote or result in increased levels of unsafe behavior at sea relative to the status quo.

The Atlantic coast bluefish fishery is predominantly a recreational fishery. The recreational fishery measures in this amendment (bag limit, size limit, and seasons) should not alter the behavior or fishing practices of fishermen to extent that they would engage in fishing practices that they would otherwise avoid. None of the measures (recreational or commercial) should affect the vessel operating environment, gear loading requirements or create derby style fisheries. The Council developed this amendment with the consultation of industry advisors to help ensure that this was the case. In summary, the Council has concluded that the proposed amendment will not impact or affect the safety of human life at sea. Therefore, National Standard 10 is met.

3.1.4 Analysis of the Preferred Management Measures

3.1.4.1 Introduction

This section presents an analysis of the impacts of the preferred management measurers considered by the Council. These actions were described in section 3.1.1 above. In this section, each management measure is analyzed in terms of biological, economic, and social impacts, and its effects to marine mammals, turtles, and sea birds. The alternatives to the preferred management measures were described in section 3.1.2 above and are analyzed in section 3.1.5 below.

3.1.4.1.1 Rebuilding schedule

Graduated reduction in fishing mortality of 40% over a nine year period (1999 to 2007) to rebuild to biomass target (B_{MSY})

<u>Biological Impacts</u>

This stock rebuilding strategy would reduce fishing mortality in a stepwise fashion over a 9 year period. Fishing mortality in 1997 was estimated at F=0.51. Total bluefish biomass would reach B_{MSY} in nine years. Table 46 shows the schedule for this recovery strategy.

Under this recovery strategy, TAC would show a small but steady increase during the first 2 years, from about 36.84 million lbs (16,710 mt) in 1999 to 43.08 million lbs (19,540 mt) in year 2000 (Table 46). In 2001, the reduction in fishing mortality would result in a small reduction in yield from the previous year. Then another increase is projected for the second block of 3 years, reaching about 59.72 million lbs (27,090 mt) in 2003. In 2004, the reduction in fishing mortality would result in a small reduction in yield from the previous year, but then yields are projected to constantly increase to 81.15 million lbs (36,810 mt) by 2007 (Table 46).

Under this preferred management alternative, the TAC for 1999 would be 36.84 million lbs (16,710 mt) (Table 46). The projected yields include commercial landings and recreational catch. As such, an estimate of recreational discards must be subtracted from the TAC to derive a TAL. Discards would be estimated for each year and subtracted from the annual TAC to derive the TAL for that year. For 1999, an estimated 1.82 million lbs (825 mt) of discards are deducted from the TAC to yield a TAL of 35.02 million lbs (15,885 mt) (Table 47). This discard level (825 mt) is equal to the average recreational discards for the period 1993 to 1996.

This rebuilding scenario, as well as those discussed below, are based on the results of a biomass dynamics model (see Appendix 1 of this document for the complete assessment) and, as such, assume that the productivity of the stock will be the same for the projected years as it was for the years used in that assessment (1974 to 1997). Bluefish are a fast growing, highly fecund fish, and given the right environmental conditions and sufficient spawning stock biomass, the stock could rebuild quickly. If recruitment is lower than anticipated, the stock projections in this alternative as well as those discussed below are optimistic. Alternatively, if recruitment is higher, the stock will rebuild at a faster rate. In addition, the Council and Commission adopted language to be included in Amendment 1 that would set the target fishing rate for the next year at the lesser of the level specified in the mortality rate reduction schedule or the level observed in the most recent year for which data are available. As such, fishing mortality rate targets could be lower than specified by the schedule and the stock could rebuild at a faster rate.

Overall impacts associated with the proposed commercial quota and recreational harvest limit are described below in sections 3.1.4.1.5 and 3.1.4.1.9, respectively.

Economic Impacts

This alternative will achieve stock rebuilding to biomass target (B_{MSY}) in 9 years. The proposed incremental decrease in fishing mortality will allow for industry adjustments while decreasing short-term adverse effects.

Under this alternative, the projected commercial quota for 1999 would be 5.95 million lbs (17% x 35.02 million lbs). This represents a decrease in commercial landings of 3.29 million lbs (36%) relative to 1996 landings. The effect of the overall bluefish exvessel price given the potential decrease in landings from the implementation of the proposed quota would depend on the elasticity of demand for bluefish. Since no study has estimated the exvessel demand function for bluefish, revenue changes from the implementation of the new quota were calculated by taking exvessel price (value divided by lbs) for 1996 and multiplying this value by the potential change in landings. Assuming the 1996 exvessel price of $0.30 per pound, the 1999 quota may potentially yield a decrease in revenues of $987,000 from the 1996 period. Assuming that this represents the initial decrease in annual revenues for all participants in the fishery, and that it is evenly distributed over all participants in the fishery (2487 vessels that landed bluefish in 1996), each business unit would lose on average $397. However, it is possible that the decrease in landings will result in an increase in exvessel price per pound, thereby mitigating some of the potential loss in revenues.

The projected recreational landings for 1999 would be 29.07 million lbs (83% x 35.02 million lbs). This would allow for an increase in recreational landings of 14.33 million lbs (97%) relative to 1996. This may result in an increase in angler satisfaction and benefits in the short-term.

These above results will occur if the recreational fishery is allocated the full 83% of the TAL. However, if the commercial sector is allowed to maintain its landings up to 10.5 million lbs, results will then be identical as those discussed under the preferred quota alternative (section 3.1.4.1.5) and preferred recreational harvest limit alternative (section 3.1.4.1.9).

This economic analysis evaluates the short-term impacts of the proposed rebuilding schedule. However, in order to evaluate the potential long-term economic impacts of the various rebuilding schedules discussed in this amendment, an analysis was conducted which provides the present discounted value of the stream of benefits associated with the various alternative rebuilding schedules. Unfortunately, the lack of economic value information for recreationally-caught bluefish does not allow for a quantitative evaluation of the recreational fishery. The Fisheries Statistics and Economics Division in the Office of Science and Technology at NMFS headquarters, is in the process of conducting recreational demand research using the 1994 economic add-on to the MRFSS survey of recreational fishermen in the North East United States. However, specific valuation estimates that would help in assessing potential changes in the recreational harvest limit for bluefish are not available (Hicks pers. comm.). As such, potential impacts associated with the various rebuilding schedules on the recreational fishery for bluefish are described qualitatively.

The TACs, TALs, recreational harvest limits, commercial quotas, and projected exvessel gross revenues associated with the five rebuilding schedules discussed in this amendment are presented in Table 47. Two of the schedules would rebuild the stock over a five year period (non-preferred alternatives 3.1.2.11.1 and 3.1.2.11.3); one would rebuild the stock over a six year period (non-preferred alternative 3.1.2.11.2), and two would rebuild the stock over a nine year period (preferred alternative 3.1.1.2 and non-preferred alternative 3.1.2.11.4). In order to compare the potential outcomes among the various rebuilding schedules, it was necessary to extrapolate the TACs for the short-term rebuilding schedules to match the time horizon of the two long-term rebuilding strategies. Therefore, the TACs for the rebuilding strategies of less than 9 years in duration were extended to allow for a side-by-side comparison of the various rebuilding schedules. This was accomplished by estimating the projected yields (associated with maximum F that would maintain the proposed target biomass) of the short-term rebuilding schedules for a few more years to match a nine year horizon. Two stream of revenues for the commercial fishery are presented for each alternative. One stream of revenues compares impacts when the commercial quota is set at 10.50 million lbs until such time as 17% of the TAL is greater than 10.50 million lbs (section 3.1.1.8.1) and the other maintains the commercial fishery at 17% of the TAL (section 3.1.1.2). The streams of recreational harvest limits associated with these two strategies are also presented.

The results indicate that under the scenario that maintains the 17/83 (section 3.1.1.2) allocation between the commercial and recreational fisheries, projected cumulative exvessel revenues for the preferred alternative is lower than that of the non-preferred alternatives. When comparing the scenario that allows the commercial quota to be set at 10.50 million lbs until such time as 17% of the TAL is greater than 10.50 million lbs (section 3.1.1.8.1), the projected cumulative exvessel revenues for the preferred alternative outperforms all but one non-preferred alternative. The non-preferred alternative that allows for a stock rebuilding strategy by maintaining a constant fishing mortality (F=0.36) over the entire recovery period indicates that the projected cumulative exvessel revenues would be higher under both scenarios. However, the preferred alternative allows for higher projected exvessel revenues during the early recovery period, e.g., 1999 to 2005 when compared with most non-preferred alternatives, and 1999-2002 when compared with the non-preferred alternative that rebuilds the stock by maintaining a constant fishing mortality (F=0.36) over the entire recovery period. As such, potential adverse economic impacts in the commercial sector would likely be reduced during the early stages of the recovery period under the preferred stock recovery schedule.

Cumulative recreational harvest limits for the preferred rebuilding schedule are lower than those for all the non-preferred alternatives. However, the preferred alternative allows for higher cumulative projected recreational harvest limits the early recovery period, e.g., 1999 to 2005 for most non-preferred alternatives. As such, recreational anglers would likely enjoy higher recreational satisfaction during the early recovery period under the preferred stock recovery schedule.

Although cumulative commercial revenues and recreational harvest limits were higher for some of the non-preferred alternatives when compared to the preferred alternative, the former was chosen by the Council because it would reduce adverse impacts to the recreational and commercial fisheries during the early years of implementation of this amendment. As such, it would minimize negative impacts to fishermen and communities while still allowing for the bluefish stock to recover in accordance with the new National Standard 1 guidelines.

Social Impacts

The proposed rebuilding schedule will achieve the total biomass target (B_{MSY}) in nine years while allowing for stability in projected yields during the recovery period. Furthermore, it provides the industry with an adjustment period during the early years of the recovery program which will minimize social impacts.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Activities conducted under this amendment have not yet been considered for their impacts on endangered species in order to do a Section 7 of the Endangered Species Act consultation. NMFS will be performing a Section 7 consultation while the amendment is out for public review during the next few months. The Fish and Wildlife Service may also perform a Section 7 consultation on any seabirds that may be impacted by this amendment. The following background information is provided to facilitate evaluations of the alternatives relative to the order of magnitude these recreational and commercial bluefish fisheries may have on these threatened or endangered species.

Numerous species of marine mammals and sea turtles occur in the northwest Atlantic Ocean. The most recent comprehensive survey in this region was done from 1979-1982 by the Cetacean and Turtle Assessment Program (CETAP) at the University of Rhode Island (University of Rhode Island 1982) under contract to the Minerals Management Service (MMS), Department of the Interior. The following is a summary of the information gathered in that study, which covered the area from Cape Sable, Nova Scotia, to Cape Hatteras, North Carolina, from the coastline to 5 nautical miles seaward of the 1000 fathom isobath.

Four hundred and seventy one large whale sightings, 1,547 small whale sightings, and 1,172 sea turtles were encountered in the surveys (Table 55). The "estimated minimum population number" for each mammal and turtle in the area, as well as those species currently included under the Endangered Species Act, were also tabulated.

CETAP concluded that both large and small cetaceans were widely distributed throughout the study area in all four seasons and grouped the 13 most commonly seen species into three categories based on geographical distribution. The first group contained only the harbor porpoise, which is distributed only over the shelf and throughout the Gulf of Maine, Cape Cod, and Georges Bank, but probably not southwest of Nantucket. The second group contained the most frequently encountered baleen whales (fin, humpback, minke, and right whales) and the white-sided dolphin. These were found in the same areas as the harbor porpoise, and also occasionally over the shelf at least to Cape Hatteras or out to the shelf edge. The third group indicated a "strong tendency for association with the shelf edge" and included the grampus, striped, spotted, saddleback, and bottlenose dolphins, and the sperm and pilot whales.

Loggerhead turtles were found throughout the study area, but appeared to migrate north to about

Massachusetts in summer and south in winter. Leatherbacks appeared to have had a more northerly distribution. CETAP hypothesized a northward migration of both species in the Gulf Stream with a southward return in continental shelf waters nearer to shore. Both species usually were found over the shoreward half of the slope and in depths less than 200 feet. The northwest Atlantic may be important for sea turtle feeding or migrations, but the nesting areas for these species generally are in the South Atlantic and Gulf of Mexico.

This problem may become acute when climatic conditions result in concentration of turtles and fish in the same area at the same time. These conditions apparently are met when temperatures are cool in October but then remain moderate into mid-December and result in a concentration of turtles between Oregon Inlet and Cape Hatteras, North Carolina. In most years, sea turtles leave Chesapeake Bay and filter through the area a few weeks before the bluefish becomes concentrated. Efforts are currently under way (by VIMS and the U.S. Fish and Wildlife Service refuges at Back Bay, Virginia, and Pea Island, North Carolina) to more closely monitor these mortalities due to trawls. Fishermen are encouraged to carefully release turtles captured incidentally and to attempt resuscitation of unconscious turtles as recommended in the 1981 *Federal Register* (pages 43976 and 43977).

The only endangered species of fish occurring in the northwest Atlantic is the shortnose sturgeon (*Acipenser brevirostrum*). The Councils urge fishermen to report any incidental catches of this species to the Regional Administrator, NMFS, One Blackburn Drive, Gloucester, Massachusetts 01930, who will forward the information to persons responsible for the active sturgeon data base.

The range of bluefish and the above mentioned marine mammals and endangered species overlap, and there always exists a potential for an incidental kill. Except in unique situations, such accidental catches should have a negligible impact on marine mammal or abundances of endangered species, and the Councils do not believe that implementation of this FMP will have any adverse impact upon these populations.

Attempts were made to put these fisheries/sea turtle interaction into perspective of other sources of mortality for these endangered turtle species. The Congressionally mandated report *Decline of the Sea Turtles: Causes and Prevention* (NRC 1990) states that "Of all the known factors, by far the most important source of deaths was the incidental capture of turtles (especially loggerheads and Kemp's ridleys) in shrimp trawling. This factor acts on the life stages with the greatest reproductive value for the recovery of sea turtle populations."

Mortality associated with other fisheries and with lost or discarded fishing gear is much more difficult to estimate than that associated with shrimp trawling, and there is a need to improve these estimates (NRC 1990). This report identified possible turtle losses from the winter trawl fishery north of Cape Hatteras (about 50-200 turtles per year), the historical Atlantic sturgeon fishery, now closed, off the Carolinas (about 200 to 800 turtles per year), and the Chesapeake Bay passive-gear fisheries (about 25 turtles per year). Considering the large numbers of fisheries from Maine to Texas that have not been evaluated and the problems of estimating the numbers of turtles entangled in the 135,000 metric tons of plastic nets, lines, and buoys lost or discarded annually, it seems likely that more than 500 loggerheads and 50 Kemp's ridleys are killed annually by nonshrimp fisheries (NRC 1990). These other fishery operations, lost fishing gear, and marine debris are known to kill sea turtles, but the reported deaths are only about 10% of those caused by shrimp trawling. Dredging, entrainment in power-plants intake pipes, collisions with boats, and the effects of petroleum-platform removal all are potentially and locally serious causes of sea turtle deaths. However these collectively amount to less than 5% of the mortality caused by shrimp trawling (NRC 1990).

The NRC report (1990) concludes that all species of marine turtles need increased protection under the Endangered Species Act and other relevant legislation. While the report does not recommend specific conservation measures for these fisheries, the recommendations for the shrimp trawling are germane. The NRC report (1990) recommended TEDs, 60 minute winter tow-time limits, and limited time/area closure for turtle "hot spots". Currently, there are 5 sea turtle recovery plans in place; these include plans for the loggerhead (1991), the green sea turtle (1991), the leatherback (1992), the Kemp's ridley sea turtle (1992), and the hawksbill sea turtle (1993). Of the six "Actions Needed" that are identified by the Recovery Plan to achieve recovery of loggerheads is item 5: "minimize mortality from commercial fisheries."

Shortnose sturgeon (*Acipenser brevirostrum*) is an additional endangered species that may be caught incidentally in trawl fisheries. Sturgeon will be included in the Incidental Take Statement of the pending Biological Opinion. As shortnose sturgeon are generally associated with the estuarine environment, rather than the truly marine environment, it is anticipated that the gear and fishing locations of these bluefish fisheries will rarely encounter shortnose sturgeon.

Marine mammals are managed under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. Marine mammals have been historically important in the U.S., both as targets for commercial harvests and in ecological interactions with commercial fisheries. An excellent description of the historical importance of marine mammals is described in USDC (1993b).

The results of this earlier work were addressed in 1979 when the U.S. Marine Mammal Commission sponsored a workshop to help define research needed for the study of marine mammals on the U.S. east and Gulf coasts and in 1989 at a NMFS-sponsored workshop on Gulf of Mexico marine mammal research needs (USDC 1993b). These workshops set a research agenda that was immediately addressed by agencies such as the Minerals Management Service and the NMFS. During the 1980's, several institutions in the northeast developed active research programs which have resulted in a body of knowledge that is being drawn upon in developing management approaches for several critical marine mammal issues in the region. In the 1990's, increased attention has been focused on the characterization of marine mammal fauna of the U.S. Gulf of Mexico and the Mid-Atlantic Bight (USDC 1993b).

Thirty-five species of marine mammals range the U.S. Atlantic and Gulf of Mexico waters (32 whales, dolphins and porpoises, two seal species, and one manatee). Their status, in general, is poorly known, but some, like the right whale, Mid-Atlantic coastal bottlenose dolphin, and harbor porpoise, are under stresses that may affect their survival (USDC 1993b).

The gears managed under this FMP are all in the third category or not listed at all for the final List of Fisheries for 1997 for the taking of marine mammals by commercial fishing operations under section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Section 114 of the MMPA establishes an interim exemption for the taking of marine mammals incidental to commercial fishing operations and requires NMFS to publish and annually update the List of Fisheries, along with the marine mammals and the number of vessels or persons involved in each fishery, arranging them according to categories, as follows:

1. A fishery that has a frequent incidental taking of marine mammals;

2. A fishery that has an occasional incidental taking of marine mammals; or

3. A fishery that has a remote likelihood, or no known incidental taking, of marine mammals.

In Category I, there is documented information indicating a "frequent" incidental taking of marine mammals in the fishery. "Frequent" means that it is highly likely that more than one marine mammal will be incidentally taken by a randomly selected vessel in the fishery during a 20-day period. No bluefish fisheries are in this category.

In Category II, there is documented information indicating an "occasional" incidental taking of marine mammals in the fishery, or in the absence of information indicating the frequency of incidental taking of marine mammals, other factors such as fishing techniques, gear used, methods used to deter marine mammals, target species, seasons and areas fished, and species and distribution of marine mammals in the area suggest there is a likelihood of at least an "occasional" incidental taking in the fishery. "Occasional" means that there is some likelihood that one marine mammal will be incidentally taken by a randomly selected vessel in the fishery during a 20-day period, but that there is little likelihood that more than one marine mammal will be incidentally taken. No bluefish fisheries are in this category.

In Category III, there is information indicating no more than a "remote likelihood" of an incidental taking of a marine mammal in the fishery or in the absence of information indicating the frequency of incidental taking of marine mammals, other factors such as fishing techniques, gear used, methods used to deter marine mammals, target species, seasons and areas fished, and species and distribution of marine mammals in the area suggest there is no more than a remote likelihood of an incidental take in the fishery. "Remote likelihood" means that it is highly unlikely that any marine mammal will be incidentally taken by a randomly selected vessel in the fishery during a 20-day period. The mixed species trawl fishery (where most bluefish are commercially caught) is considered a Category III fishery. With the mandatory reductions in bluefish fishing mortality in the preferred alternative, there should be a beneficial impact from the preferred alternative management measures on the marine mammal populations of the east coast.

Pelagic seabirds may also come into contact with bluefish fisheries. Most of the following information is taken from the Mid-Atlantic Regional Marine Research Program (1994) and Peterson (1963). Fulmars occur as far south as Virginia in late winter and early spring. Shearwaters, storm petrels (both Leach's and Wilson's), jaegers, skuas, and some terns pass through this region in their annual migrations. Gannets and phalaropes occur in the Mid-Atlantic during winter months. Eight gulls breed in eastern North America and occur in shelf waters off the northeastern U.S. These gulls include: glaucous, Iceland, great black-backed, herring, laughing, ring-billed, Bonaparte's, and Sabine's gulls and black-legged caduceus. Royal and sandwich terns are coastal inhabitants from Chesapeake Bay south to the Gulf of Mexico. The Roseate tern is listed as endangered under the ESA, while the Least tern is considered threatened (Safina pers. comm.). Of course, our national symbol, the bald eagle is listed as endangered under the ESA and is a bird of aquatic ecosystems. Literally translated, its Latin name, *Haliaeetus leucocephalus*, means white-headed sea eagle (*Federal Register* 1994, 35584). Prey of estuarine inhabiting bald eagles may include bluefish (D'Amico pers. comm.)

Bluefish are not important prey for the Common and Roseate terns (Safina 1987, Safina *et al.* 1988, and Safina *et al.* 1990). Safina *et al.* (1988) note that few other seabird studies have measured ambient food levels among foraging birds, but many studies which have examined food provisioning to chicks and reproductive performance in seabirds have found results similar to theirs. Laying dates, clutch sizes, growth, and fledgling success of seabirds have been linked to food availability by a number of workers. Safina *et al.* (1988) recorded that prey fish were more abundant in 1984 than in 1985 and noted that reproductive productivity of terns was greater in 1984 for most parameters measured. Although they studied productivity for only two seasons, the results suggest that prey population fluctuations may limit reproductive success in the terns they studied.

Safina *et al.* (1990) noted that observing prey deliveries at nests cannot address the question of how foraging birds select prey or foraging habitat from the range of possibilities. However, the variability they found show that either prey availability or birds' selection criteria changes, and that prey availability or selection varies differently between the two tern species, Common and Roseate, they studied. Some prey species may have their own consistent internal rhythms (or influencing factors) which make them differentially susceptible to tern predation on a daily time scale.

A definitive analyses of the importance of bluefish for the diets of pelagic seabirds and marine mammals has not yet been conducted. Alaska Sea Grant (1993) sponsored a workshop in 1993 entitled *Is It Food* which addressed the importance of Alaskan fish prey for marine mammal and seabird declines. A similar workshop for Northwest Atlantic interactions would be beneficial.

The stock recovery schedule proposed in this amendment will reduce fishing mortality over a nine-year period. As such, these reductions in fishing mortality will result in reduced fishing effort that in turn will reduce interactions with marine mammals, sea turtles, shortnose sturgeon, and seabirds. As noted earlier, bluefish may be important in the diets of some seabirds, marine mammals, and various fishes. Preventing overfishing of bluefish may thus be beneficial to some seabirds and certain species of marine mammals.

3.1.4.1.2 Permit requirements: commercial and party/charter vessels

Commercial permits for bluefish

Biological Impacts

There are no direct biological impacts associated with the implementation of this management alternative. However, this alternative will help track the quota and therefore reduce the chance that the quota is exceeded and, as such, reduce the chance of overfishing. A commercial permit to sell is essential for a quota based management system.

Economic Impacts

It is estimated that 2,487 commercial vessels landed bluefish in 1996 along the Atlantic coast. Under this alternative, any owner of a vessel desiring to fish commercially for bluefish in the EEZ must obtain a federal or state vessel permit. Assuming that 90% of the vessels currently fishing for bluefish commercially already hold a valid NMFS permit for one or more additional fisheries, then 249 new applicants would be required to apply by using the initial application form. The remainder would use the renewal form and would not likely incur an additional burden. It is estimated that all 249 vessels would apply for a bluefish permit in order to maintain flexibility of fishing operations. The total burden cost associated with public requirements is $1,868 ($7.5 per vessel). The total burden cost associated with federal requirements is estimated at $8,217 ($33 per application). The 249 new applicants would be required to have vessel identification. The cost for paint, brush, stencil and labor for vessel identification is approximately $5,291 ($21 per vessel)

Licensed commercial vessels permits issued pursuant to this amendment must submit monthly logbooks. It is estimated that most commercial vessels participating in the bluefish fishery hold one or more permits for fisheries that require logbook submission (e.g., multispecies, summer flounder, black sea bass, scup, snapper grouper complex, etc.). As such, only vessels that are new applicants for commercial permits (249) would be required to submit new logbook reporting requirements. The total burden costs associated with public requirements is $4,959 ($20 per vessel per year). The total burden cost associated with federal requirements is estimated at $6,223.

This alternative would modify the current permit system. Under the current bluefish regulations, any person selling a bluefish would be identified as a commercial fisherman and must have a commercial fishing permit that allows the sale of bluefish (i.e., the individual is licensed). NMFS permit files indicate that since the implementation of the Bluefish FMP, approximately 2,356 bluefish permits has been issued to individuals (October 16, 1998). Currently (October 20, 1998), there are 1,121 valid Bluefish permits issued to individuals. All individual permits must be renewed at the end of every year, and are canceled if the holder does not return the renewal form.

It is not possible to determine the number of individuals holding Bluefish permits that actually land and sell bluefish. It is also not possible to determine if the permitted individual that lands and sell bluefish fishes from a commercial vessel, party/charter boat, or from shore. However, it is believed that the bulk of the bluefish that enters the market are harvested by commercial vessels. These vessels will be allowed to continue to land bluefish if they obtain a federal or state commercial vessel permit. As such, the elimination of individual permits in this fishery will not affect those individuals.

Individuals that fish exclusively from shore, man-made structures, or party/charter boats will not be allowed to sell bluefish. It is likely that the amount of bluefish sold under these circumstances is small. Given the generally low exvessel price for bluefish, it is not expected that the elimination of the individual bluefish permit will reduce the revenue of those individuals substantially.

Social Impacts

Any owner of a vessel desiring to fish for bluefish within the U.S. EEZ for sale, or transport or deliver for sale, any bluefish taken within the EEZ, must obtain a permit from NMFS for that purpose.

The current FMP requires that *individuals* possess a commercial license to sell bluefish. Virtually every other federal FMP currently in effect in the Northeast region of the U.S. requires that the vessel be licensed. The benefit of this option is that the harvest capacity or fishing power of the fleet can be determined and controlled when the vessel is licensed rather than the individual. Under the current system of licensing the individual, the individual can fish from any vessel or platform without limit to size or horsepower. Under this system, the degree of capitalization of the fleet cannot be determined. If the vessels were licensed, the degree to which capitalization and fishing power of the fleet needs to be regulated could be more clearly evaluated.

The issuance of a permit is an essential ingredient in the management of fishery resources. Section 303(b)(1) of the MSFCMA specifically recognized the need for permit issuance. Almost every international, federal, state, and local fishery management authority recognizes the value of permits and uses permits as part of their management systems. The purpose and use of permits is to: 1) register fishermen, fishing vessels, fish dealers, and processors, 2) list the characteristics of fishing vessels and/or dealer/processor operations, 3) exercise influence over compliance (e.g., withhold issuance pending collection of unpaid penalties), 4) provide a mailing list for the dissemination of important information to the industry, and 5) provide a universe for data collection purposes.

Commercial fishing permit information can be used by enforcement officials to check for regulatory infractions, and by NOAA scientists and economists as a basis for analysis. The commercial fishing permit requirement ensures more complete reporting from the fishery. Commercial fishing permits will increase compliance with commercial quota management. With the implementation of a commercial fishing permit, the quota system should be tracked more accurately. Therefore, permit requirements will enhance enforcement.

Effects on Marine Mammals, Sea Turtles, and Seabirds

The various permitting processes preferred for this bluefish amendment for the commercial fishery, party/charter boat fishery, dealers, and operators will not have any significant impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

Party/Charter permits for bluefish

Biological Impacts

There is no direct biological impacts associated with the implementation of this management alternative. However, a permit requirement for party/charter vessels will allow for the collection of better data on this sector of the fishery. Better data will allow for more effective management measures which will in turn benefit the bluefish stock.

Economic Impacts

In 1994, there were approximately 2,630 party/charter vessels operating along the Atlantic coast (ASMFC 1994). The catch, fishing technique and area fished for those vessels is diverse. Approximately 1,373 party/charter vessels were active and/or caught bluefish in the North and Mid-Atlantic regions in 1994. It is expected that all of these vessels will apply for a party/charter vessel permit in order to maintain flexibility in their operations.

The number of party(head)/charter vessels participating in the bluefish fishery in the South Atlantic is unknown. However, the number of bluefish landed by headboats in the South Atlantic is small. For example, an average of 3,876 bluefish were landed annually between Morehead City, North Carolina and Key West, Florida by headboats during the 1991-1996 period (Dixson pers. comm.). Headboat operators do not target bluefish in the South Atlantic (Dixson pers. comm., Fedler pers. comm.). Headboats in the South Atlantic mostly target species in the snapper grouper complex. In North Carolina, most bluefish are caught when reef fishing or fishing for Spanish mackerel. Therefore, they are considered as incidental catch (Dixson pers. comm.). There are between 85 to 95 headboats operating in the South Atlantic region. Twenty of these boats operate in the area of the Florida Keys and do not fish for bluefish (Dixson pers. comm.). Therefore, it can be estimated that approximately 75 headboats may catch some bluefish in the South Atlantic region and thus apply for a party/charter vessel permit.

Charter boats in the South Atlantic do not generally target bluefish, with the exception of the charter boat fishery in northern North Carolina which targets bluefish in the spring and fall (Fedler pers. comm.). There are approximately 190 charter boats operating in North Carolina (Mumsord pers. comm.). It is expected that they will all apply for a party/charter vessel permit.

In South Carolina between, 111 to 135 charter boats have been operating in the recreational fishery. The principal species targeted by the South Carolina charter boat fleet include red drum, spotted seatrout, sheepshead, tarpon, sharks, dolphin, wahoo, tuna, billfish, King mackerel, and Spanish mackerel (Low 1998). Bluefish is not targeted by the charter fleet in South Carolina. The number of bluefish caught by charter boats in South Carolina in 1996 were less than 1,300 (Low

1998). It is expected that all these boats will all apply for a party/charter vessel permit.

There are 70 saltwater charter boats which operate in Georgia, none of which target bluefish but may catch them incidentally (Nichelson pers. comm.). It is expected that all these boats will apply for a party/charter vessel permit.

Finally, it was estimated that approximately 220 saltwater fishing licenses for vessels carrying between 5-10 passengers were sold in the east coast of Florida for the fiscal year 1996-1997 (Norris pers. comm.). If it is assumed that this type of license best represents the average license sold for charter boat operations in that region, then about 220 charter boats are expected to be operating in the Florida east coast (excluding Monroe County where bluefish is seldom landed by charter boats). It is expected that all of these vessels would apply for a party/charter vessel permit.

Therefore, it is estimated that approximately 2,063 party/charter vessels would apply for a bluefish party/charter vessel permit coastwide. Since these vessels already hold permits for other party/charter fisheries, and the party/charter permit will remain open access, it is not likely that additional burden (public costs or government costs) will be incurred. Licensed party/charter vessels permits issued pursuant to this amendment must submit monthly logbooks. It is estimated that all party/charter vessels participating in the bluefish fishery hold one or more permits for fisheries that require logbook submission (e.g., multispecies, summer flounder, black sea bass, scup, snapper grouper complex, etc.). As such, these vessels are only required to submit one report to meet the reporting requirement for these fisheries. Therefore, no additional burden is anticipated by the addition of bluefish to the list.

Social Impacts

Recreational landings of bluefish along the Atlantic coast of the United States comprised over 80% of the total bluefish landings for the 1981 to 1996 period combined (Table 23). The percentage of bluefish landed (weight) by party/charter boats from Maine to Florida was 26% of the total bluefish landed by all fishing modes for the 1987 to 1996 period (Table 34).

The issuance of a permit is an essential ingredient in the management of fishery resources. Section 303(b)(1) of the MSFCMA specifically recognized the need for permit issuance. Almost every international, federal, state, and local fishery management authority recognizes the value of permits and uses permits as part of their management systems. The purpose and use of permits is to: 1) register fishermen, fishing vessels, fish dealers, and processors, 2) list the characteristics of fishing vessels and/or dealer/processor operations, 3) exercise influence over compliance (e.g. withhold issuance pending collection of unpaid penalties), 4) provide a mailing list for the dissemination of important information to the industry, and 5) provide a universe for data collection purposes.

Experience has shown that fines for violations of specific fishery regulations are not as effective as the threat of withdrawing or not renewing permits. Fines for fishing without a permit can be more substantial and easier to enforce than fines for other violations. Vessels owners may be willing to pay the lower fines if the violation brings enough economic benefit, but do not want to be excluded from the fishery. Therefore, permit requirements may enhance enforcement.

Effects on Marine Mammals, Sea Turtles, and Seabirds

The various permitting processes preferred for this bluefish amendment for the commercial fishery, party/charter boat fishery, dealers, and operators will not have any significant impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.4.1.3 Dealer permit

Biological Impacts

Dealer permits will increase the probability that dealers buy only bluefish that has been legally caught. Dealers will be required to submit weekly reports describing their bluefish purchases. This information will be used by NMFS to track real time bluefish landings and the overall status of the bluefish quota. Therefore, permits will increase compliance with quota management, increase the effectiveness of management measures and thus benefit the stock.

Economic Impacts

The number of dealers which currently buy and sell bluefish is unknown. However, the number of dealers in the summer flounder fishery can be employed as a reasonable proxy to estimate the potential number of dealers that will apply for a dealer permit. There are 365 dealers holding federal permits in the summer flounder fishery (Maine to North Carolina). It is assumed that approximately 10% of that number would be new applicants for the bluefish fishery in the Mid-Atlantic and South Atlantic regions. In addition to this, there are about 60 commercial fish dealers on the east coast of Florida dealing with bluefish (Brown pers. comm.). These dealers have state dealers permit and as such do not have to apply for a federal dealer permit as long as the state of Florida forwards the necessary information to the Regional Administrator (section 3.1.1.5). All of the bluefish dealers in the east coast of Florida are likely to be reporting on a weekly basis for one or more species under quota management (e.g., snapper grouper, King mackerel, etc.). Thus, no additional reporting burden is anticipated for these dealers. Bluefish landings in Georgia and South Carolina are very small (0.022% of the total commercial landings or about 2,000 lbs for 1996), therefore, it is assumed that there are no bluefish dealers in these states.

It is then expected that 37 (10% x 365) dealers would be new applicants for the bluefish fishery. The calculation of public and federal estimate of reporting costs apply to the new respondents only (37 new dealers). The total burden cost associated with public requirements is $46 ($1.25 per dealer). Thereafter, the public annual estimate of submitting weekly reports will be $960 ($26 per dealer per year). The NMFS burden costs associated with the processing of the initial permit application will be $1,221. Thereafter, the annual estimate of processing weekly reports for the NMFS will be $1,602.

Social Impacts

The issuance of a permit is an essential ingredient in the management of fishery resources. Section 303(b)(1) of the MSFCMA specifically recognized the need for permit issuance. Almost every international, federal, state, and local fishery management authority recognizes the value of permits and uses permits as part of their management systems. The purpose and use of permits is to: 1) register fishermen, fishing vessels, fish dealers, and processors, 2) list the characteristics of fishing vessels and/or dealer/processor operations, 3) exercise influence over compliance (e.g., withhold issuance pending collection of unpaid penalties), 4) provide a mailing list for the dissemination of important information to the industry, and 5) provide a universe for data collection purposes.

Dealer information can be used by enforcement officials to check for regulatory infractions and by NOAA scientists and economists as a basis for analysis. The dealer permit requirement ensures more complete reporting from the fishery. The reports provide important information on the volume, value, and distribution of bluefish at the point of first purchase. Dealer permits will increase compliance with commercial quota management. With the implementation of a dealer permit, the quota system should be tracked more accurately. Therefore, permit requirements will enhance enforcement.

Effects on Marine Mammals, Sea Turtles, and Seabirds

The various permitting processes preferred for this bluefish amendment for the commercial fishery, party/charter boat fishery, dealers, and operators will not have any significant impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.4.1.4 Operator permit

Biological Impacts

There are no direct biological impacts associated with the implementation of this alternative.

Economic Impacts

All commercial and recreational operators should already have an operator permit issued by NMFS or a state under other management plans. It is not expected that the implementation of this management alternative will affect the public or NMFS burden cost.

Social Impacts

The issuance of a permit is an essential ingredient in the management of fishery resources. Section 303(b)(1) of the MSFCMA specifically recognized the need for permit issuance. Almost every international, federal, state, and local fishery management authority recognizes the value of and uses permits as part of their management systems. The purpose and use of permits is to: 1) register fishermen, fishing vessels, fish dealers, and processors, 2) list the characteristics of fishing vessels and/or dealer/processor operations, 3) exercise influence over compliance (e.g., withhold issuance pending collection of unpaid penalties), 4) provide a mailing list for the dissemination of important information to the industry, and 5) provide a universe for data collection purposes.

Operator permits are important because they hold vessel operators accountable for violations of fishing regulations, therefore improving compliance with the amendment.

Experience has shown that fines for violations of specific fishery regulations are not as effective as the threat of withdrawing or not renewing permits. Fines for fishing without a permit can be more substantial and easier to enforce than fines for other violations. Vessels owners may be willing to pay the lower fines if the violation brings enough economic benefit, but do not want to be excluded from the fishery. Therefore, permit requirements may enhance enforcement.

Effects on Marine Mammals, Sea Turtles, and Seabirds

The various permitting processes preferred for this bluefish amendment for the commercial fishery, party/charter boat fishery, dealers, and operators will not have any significant impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.4.1.5 Commercial quota

Biological Impacts

A quota would be allocated to the commercial fishery to control fishing mortality. The quota would be based on stock assessment information on projected stock size estimates for that year. Estimates of stock size coupled with the target fishing mortality rate would allow for a calculation of total allowable landings. Based on the historic proportions of commercial and recreational landings for 1981 to 1989, 17% of the total target would be allocated to the commercial fishery.

The base period, 1981 to 1989, was chosen by the Council and Commission as the preferred allocation period because it represents the years prior to the regulations that may have affected both recreational and commercial landings (i.e., prior to the approval of the Bluefish FMP in 1990). Given these considerations, the Council and Commission considered that this period would result in the most fair allocation of the resource.

To assess potential short-term impacts of the allocation, the 1999 TAC projections of 36.84 million lbs (16,710 mt) associated with the preferred stock rebuilding schedule described in section 3.1.4.1.1 were used. The projected yields include commercial landings and recreational catch. As such, an estimate of recreational discards must be subtracted from the TAC to derive a total allowable landings (TAL). Discards would be estimated for each year and subtracted from the annual TAC to derive the TAL for that year. For 1999, an estimated 1.82 million lbs (825 mt) of discards are deducted from the TAC to yield a TAL of 35.02 million lbs (15,885 mt) (Table 47). This discard level (825 mt) is equal to the average recreational discards for the period 1993 to 1996.

The commercial share of the projected TAL for 1999 would be 5.95 million lbs (17% x 35.02 million lbs). This represents a decrease in commercial landings of 3.29 million lbs (36%) relative to 1996. However, under this management alternative, if the recreational sector was not projected to land their entire allocation of 29.07 million lbs (35.02 million lbs x 83%) in 1999, then the commercial sector could increase landings by up to 10.5 million lbs (4,763 mt). That is, the commercial sector would be allowed to maintain their landings until the recreational sector was able to land their entire allocation. Under this alternative, recreational landings from the prior year would be compared to the proposed harvest limit. If, based on this comparison, the recreational fishery was not anticipated to land their limit, the commercial quota would be set up to 10.50 million lbs (4,763 mt). This is the average commercial landings for the period 1990-1997. However, if the recreational component of the landings was projected to reach the allocation for that year (83%), then the 83/17 allocation would be implemented without transfers.

Recreational landings were 14.74 million lbs in 1996. Since 1981, bluefish recreational landings have generally declined, reflecting a drop in availability and/or angler interest. From 1981 to 1996, the percentage of interviewed anglers identifying bluefish as the primary species sought has decreased in the North Atlantic region from 21% to 12%, from 17% to 8% in the Mid-Atlantic region, and from 6% to 2% in the South Atlantic region (MRFSS unpublished data). It is not expected that recreational anglers would substantially increase landings in 1999 versus 1997. As such, the commercial fishery would be allocated up to 10.50 million lbs in 1999.

The implementation of this alternative may allow the commercial fishery to take a larger proportion of bluefish in the early years than it would have taken based on historical proportions of commercial landings from 1981-1989. However, the overall TAL would not be exceeded, and the biological impacts would be the same as the overall impacts identified in this section.

The state-by-state quota system would allow for the most equitable distribution of the commercial quota to fishermen. Specifically, states under this alternative would have the responsibility of managing their quota for the greatest benefit of the commercial bluefish industry in their state.

States could design allocation systems based on trip limits and seasons. States would also have the ability to transfer or combine quota increasing the flexibility of the system to respond to year to year variations in fishing practices or landings patterns.

The commercial quota will control mortality on fully recruited, older fish. The ability to close the fishery is a very powerful tool in controlling mortality. Bycatch can be accounted for by closing the directed fishery soon enough to allow for the bycatch and, to the extent the quota is exceeded, by appropriately reducing the next year's quota. This combination seems to be the most reasonable compromise between stopping all fishing that may result in additional bluefish mortality and allowing fishing to continue and making all adjustments in the subsequent year's quota. Since bluefish may only be sold by an individual possessing a commercial bluefish permit, the bluefish bycatch will be accounted for by the reporting system.

Combined, the minimum mesh, minimum fish size regulation, and the commercial quota will prevent overfishing and reduce waste in the commercial sector. The commercial quota will be based on the commercial share (17%) of a total quota which under average or above average conditions would be equal to landings corresponding to F's associated with the preferred stock rebuilding schedule described in section 3.1.4.1.1.

Economic Impacts

Under this alternative, the commercial fishery would be allowed to increase landings by up to 10.50 million lbs (5.95 million lbs derived from the original allocation + 4.55 million lbs of transfer) in 1999. This would represent an increase in landings of 1.2 million lbs (13%) relative to 1996.

The effect of the overall bluefish exvessel price given the potential increase in landings from the implementation of the proposed quota would depend on the elasticity of demand for bluefish. Since no study has estimated the exvessel demand function for bluefish, revenue changes from the implementation of the new quota were calculated by taking exvessel price (value divided by lbs) for 1996, and multiplying this value by the potential change in landings. Assuming the 1996 exvessel price of $0.30 per pound, the 1999 quota may potentially yield an increase in revenues of $363,600 from the 1996 period. Assuming that this represents the initial decrease in annual revenues for all participants in the fishery, and that it is evenly distributed over all participants in the fishery (2487 vessels that landed bluefish in 1996), each business unit would gain on average $146. However, it is possible that the increase in landings will result in a decrease in exvessel price per pound, thereby mitigating some of the potential gain in revenues.

The commercial sector may benefit from the potential increase in landings if the recreational component of the catch is less than 83% of the TAL. With the implementation of this alternative, revenues associated with commercial landings would remain relatively stable.

Social Impacts

The commercial fishery and the associated industries and communities would benefit under this alternative since landings would remain constant. However, recreational fishermen may consider this alternative unfair since it allows for increased harvest in the commercial fishery. This alternative would allow the commercial fishery to maintain landings up to 10.50 million lbs (average landings for the past 7 years) as long as the recreational sector is not projected to reach 83% of the total TAL. As such, commercial landings and revenues are expected to remain relatively stable. The implementation of this alternative may allow the commercial fishery to take a larger proportion of bluefish in the early years than it would have taken based on historical proportions of commercial landings from 1981-1989. Furthermore, it is expected that the commercial quota combined with other management actions (e.g., minimum mesh, minimum fish size regulation) will prevent overfishing and reduce waste in the commercial sector. This will in turn increase benefits in the commercial fishery in the long-term.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Because the quota will keep commercial landings constant if the recreational sector is not projected to land their entire allocation of 83% of the TAL, contacts with endangered and threatened sea turtles, shortnose sturgeon, seabirds, and marine mammals should not increase in the near-term.

3.1.4.1.6 Commercial minimum fish size

Biological Impacts

Historic commercial length frequencies can be used as an estimate of potential short-term impacts of length limits on the commercial bluefish fisheries. As an example, the potential short-term effects of a 12" TL minimum size limit in the commercial fishery is used to illustrate the overall analytical process that may be employed to assess consequences of a minimum size limit. The biological, economic and social impacts of this hypothetical minimum size limit are discussed in this section.

Specifically, commercial length frequencies from the NMFS Weighout Data and the state of North Carolina from 1987 to 1996 were used to determine potential size limit effects (Tables 56-59). In general, size frequency data indicated that potential size limit effects were gear dependent and varied from one year to the next.

Based on NMFS weighout data for 1987-1996, approximately 1% of the measured bluefish were less than 12" TL for all gears with sampled landings (Table 56). During the same time frame, no bluefish less than 6" TL were measured while 59.9% were less than 23" TL based on the NMFS weighout data. Based on North Carolina data (1987-1996), the percent of fish measured less than 12" TL ranged from 2.9%-93.7% (Table 57). The two gears associated with most of the commercial landings coastwide were otter trawls and gill nets which accounted for the largest percentage of the coastwide landings based on 1987-1996 unpublished NMFS weighout data (Table 24). Size limit effects varied annually (Tables 56 and 57) and by gear type (Tables 58 and 59).

In this example, the minimum size limit initially specified at 12" TL would protect age 0 bluefish. Based on length at age data, age 0 bluefish average 9.1" TL and range from 5.5" to 12.5" TL. Thus a 12" TL minimum size limit will protect virtually all young of the year bluefish.

Assuming that undersized fish are not caught and discarded, minimum size regulations have positive impacts on the stock. In general, because minimum sizes increase the size at full recruitment, yields are increased as fishermen catch larger, heavier fish. In addition, minimum size regulations can increase the resilience of the stock to overfishing, i.e., the biological reference points (F_{MSY}) can increase. Finally, minimum size regulations can increase spawning stock biomass by allowing more fish to spawn.

Economic Impacts

The economic impact on the commercial sector from the implementation of this hypothetical minimum size limit will vary between regions and gears employed. In general terms, the reduction in revenues in the short-term is expected to be small or of no significant economic impact.

Weighout data collected by the Northeast Fishery Science Center indicates that for the 1987-1996 period, approximately 1% of the measured bluefish were less than 12" TL for all gears with sampled landings (Table 56). According to the same data, no single gear was identified as landing significant percentages of bluefish measuring less than 12" TL. Therefore, it is expected that the decrease in revenues for fishermen from Maine to Virginia as the result of the implementation of this minimum size limit would not be substantial. More specifically, the 12" TL size limit will reduce landings from Maine to Virginia in 1999 about 31,500 lbs. Assuming a bluefish exvessel price of $0.30 (1996 value), $9,450 gross revenues from bluefish would be lost in the first year. Assuming this initial decrease in annual revenues for all participants in the fishery (Maine to Virginia) and is evenly distributed over all participants in the fishery, each business unit would lose approximately $10. In 1996, bluefish accounted for less than 1% of the of the total revenues for the vessels that landed bluefish from Maine to Virginia.

Based on commercial length data collected from 1987 to 1996 in North Carolina, the percent of measured bluefish less than 12" TL ranged from 2.9 to 93.7% (Table 57). In 1996, North Carolina commercial bluefish landings accounted for 35% of the total coastwide landings of bluefish. North Carolina commercial data for the 1987-1996 period indicates that four major gear types accounted for considerable landings of measured bluefish less than 12" TL (Table 59).

For the 1987 to 1996 period, pound net gear accounted for the largest proportion (64.2%) of commercial measured bluefish less than 12" TL in North Carolina (Table 59). The total commercial value of bluefish landed by pound net in North Carolina has decreased in the last decade, from $16,000 in 1987 to $900 in 1996. On average (1987-1996), pound nets accounted for 0.9% (31,085 lbs) and 0.7% ($5,100) of the total bluefish landings and value in North Carolina, respectively (North Carolina Division of Marine Fisheries, 1997). However, on average (fiscal years 94-95, 95-96, and 96-97) for vessels that landed bluefish employing pound net gear, bluefish accounted for 0.51% of the total value landed by those vessels (Watterson pers. comm.). Assuming that these vessels were to stop landing bluefish less than 12" TL, it would be expected that about 64.2% of their bluefish landings would be lost. This could result in reduced landings of 2,175 lbs in the first year. Assuming an exvessel price of $0.30 per pound (1996 value), this would result in a reduction in gross revenue from the sale of bluefish of $653 in the first year. Assuming this initial decrease in annual revenues for all participants employing this type of gear and is evenly distributed over all participants, each business unit would lose $19 during the first year. The bluefish contribution to the total landed value for vessels that landed bluefish by employing pound net gear in North Carolina may then decrease, on average, from 0.51% to 0.07% in the first year.

For the 1987 to 1996 period, long haul seine gear accounted for the second largest proportion (53.7%) of commercial measured bluefish less than 12" TL in North Carolina (Table 59). The total commercial value of bluefish landed by long haul seines in North Carolina has decreased in the last decade, from $72,000 in 1987 to $11,000 in 1996. On average (1987-1996), long haul seine accounted for 6.6% (232,367 lbs) and 5.8% ($41,599) of the total bluefish landings and value in North Carolina, respectively (North carolina Division of Marine Fisheries 1997). However, on average (fiscal years 94-95, 95-96, and 96-97) for vessels that landed bluefish employing long seine haul gear, bluefish accounted for 2.69% of the total value landed by those vessels (Watterson pers. comm.). Assuming that these vessels were to stop landing bluefish less than 12" TL, it would be expected that about 53.7% of their bluefish landings would be lost. This could result in reduced landings of 25,309 lbs in the first year. Assuming an exvessel price of $0.30 per pound (1996 value), this would result in a reduction in gross revenue from the sale of bluefish of $8,806 in the first year. Assuming this initial decrease in annual revenues for all participants employing this type of gear and is evenly distributed over all participants, each business unit would lose $180 during the first year. The bluefish contribution to the total landed value for vessels that landed bluefish by employing long haul seine gear in North Carolina may then decrease, on average, from 2.69% to 1% in the first year.

For the 1987 to 1996 period, otter trawl gear accounted for the third largest proportion (8.2%) of commercial measured bluefish less than 12" TL in North Carolina (Table 59). The total commercial value of bluefish landed by otter trawls in North Carolina has decreased in the last decade, from $72,200 in 1987 to $59,500 in 1996. On average (1987-1996), pound net (flounder and sciaenid) accounted for 12.9% (452,609 lbs) and 11.6% ($83,500) of the total bluefish landings and value in North Carolina, respectively (North Carolina Division of Marine Fisheries, 1997). However, on average (fiscal years 94-95, 95-96, and 96-97) for vessels that landed bluefish employing otter trawl gear, bluefish accounted for 3.31% of the total value landed by those vessels (Watterson pers. comm.). Assuming that these vessels were to stop landing bluefish less than 12" TL, it would be expected that about 8.2% of their bluefish landings would be lost. This could result in reduced landings of 20,431 lbs in the first year. Assuming an exvessel price of $0.30 per pound (1996 value), this would result in a reduction in gross revenue from the sale of bluefish of $6,129 in the first year. Assuming this initial decrease in annual revenues for all participants employing this type of gear and is evenly distributed over all participants, each business unit would lose $133. The bluefish contribution to the total landed value for vessels that landed bluefish by employing otter trawl gear in North Carolina may then decrease, on average, from 3.31% to 2.97% in the first year.

For the 1987 to 1996 period, sink net gear accounted for the fourth largest proportion (4.5%) of commercial measured bluefish less than 12" TL in North Carolina (Table 59). The total commercial value of bluefish landed by sink gill net in North Carolina has increased in the last decade, from $519,700 in 1987 to $697,500 in 1996. On average (1987-1996), sink nets accounted for 59.8% (2,095,273 lbs) and 64.2% ($460,500) of the total bluefish landings and value in North Carolina, respectively (North Carolina Division of Marine Fisheries, 1997). However, on average (fiscal years 94-95, 95-96, and 96-97) for vessels that landed bluefish employing sink net gear, bluefish accounted for 3.31% of the total value landed. Assuming that these vessels were to forego revenues from landing bluefish less than 12" TL, it would be expected that about 4.5% of their bluefish landings would be lost. This could result in reduced landings of 101,492 lbs in the first year. Assuming an exvessel price of $0.30 per pound (1996 value), this would result in a reduction in gross revenue from the sale of bluefish of $30,448 in the first year. Assuming this initial decrease in annual revenues for all participants employing this type of gear and is evenly distributed over all participants, each business unit would lose $87. The bluefish contribution to the total landed value for vessels that landed bluefish by employing sink net gear in North Carolina may then decrease, on average, from 29.43% to 28.51% in the first year.

In general, bluefish contributed 1.01% of the total finfish exvessel revenues in North Carolina in 1996 (unpublished General Canvass Data). Overall, the implementation of this hypothetical minimum size limit would not be expected to have a significant economic impact on the commercial fishermen in North Carolina.

In South Carolina, Georgia, and Florida, the economic impact from this alternative are also expected to be minimal. On average, in the last decade, South Carolina and Georgia have landed 0.022% of the total coastwide bluefish landings. In 1996, bluefish landings contributed 0.026% of the total finfish landings value for the states of South Carolina and Georgia, combined (unpublished

Weighout data). Therefore, given the amount and value of bluefish landings in Georgia and South Carolina, it is not expected that the implementation of this management action will have a significant negative impact of the fishermen in those states. Bluefish landings in Florida account for 8.9% of the total coastwide bluefish landings during the last decade. Since 1986, bluefish landings have decreased considerably in Florida (Table 29), reaching a record low of 133,000 lbs in 1996 (post-netban period). Bluefish landed in Florida are mainly caught as bycatch, and in 1996, bluefish accounted for slightly under 6% of the total value of bluefish trips (Brown pers. comm.). This value would likely decrease considerably if the value of all species landed by vessels that landed bluefish not only during bluefish trips, but all trips throughout the year, were considered. The total exvessel value of bluefish landings in 1996 represented 0.25% of the total exvessel value of the landings of all finfish species combined in that state. Based on commercial data collected in 1996 (as May 6 1996) from the Florida east coats, 74.4% of the measured bluefish was greater than or equal to 15" TL. The same data also indicated that 25.7% of the measured bluefish was between 11.69" and 15" TL (Brown pers. comm.). Thus, the amount of landed bluefish less than 12" TL in the east coast of Florida is likely to be very small.

Overall, the hypothetical 12" TL action is not expected to have a significant adverse economic effect on bluefish fishermen. Benefits of a minimum fish size restriction in the commercial bluefish fishery would result from increased catches of larger bluefish in future years. Gains will accrue to fishermen through protecting small bluefish until they reach legal size. This management measure will result in a short-term reduction in the marketable catch and long-term benefits as more fish mature and increase the size of the spawning stock. In addition, a reduction in the mortality of small bluefish will allow for an increase in yield or harvest as small fish that were previously killed grow larger and add weight to the stock.

Social Impacts

A commercial fish size limitation would reduce the commercial catch. If commercial fishermen can substitute the potential income loss by landing another species without additional effort, they may see no negative impact. However, if this is not possible, short-term impacts could occur. Nevertheless, given the analysis conducted under economic impacts above, it is not anticipated that commercial fishermen will be faced with substantial income loss as the result of the minimum size limit. Furthermore, minimum fish size restriction in the commercial bluefish fishery could result in increased catches of larger bluefish in future years, increasing benefits in the long-term.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Since less than one percent of the commercially caught bluefish have been smaller than 12", there should not be any significant increase in fishing effort to make up for this small foregone catch. Thus, a minimum fish size of 12" will not have any significant impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.4.1.7 Commercial minimum mesh size

Biological Impacts

Discard mortality may be high for trawl and gill net caught bluefish unless appropriate mesh sizes are implemented. The discard problem could be acute when new year classes are abundant. The benefits of any proposed minimum mesh and fish size regulation will be manifested through a more balanced age structure of the bluefish stock. If the proper mesh size is implemented, waste could be reduced due to (1) lower total discards and (2) lower mortality of net encounter.

Economic Impacts

There are no direct economic impacts associated with this alternative. This alternative is presented as a framework provision. That is, it would allow for modifications in minimum mesh requirements based on updated stock assessments, as well as other information such as changes in fishing practices and activities. Adverse impacts would therefore be measured against the prevailing rate of fishing success and would not be as great as when bluefish are abundant or fishermen effort is less. This alternative is expected to add flexibility to the management process. This added flexibility would allow for rapid management response which, in turn, should benefit user groups at some future period. The overall net benefit of this management alternative is expected to be positive.

Social Impacts

This provision is intended to allow for the implementation and change in minimum mesh size. In turn this could be used to address potential problems associated with discard mortality. The proper management of the bluefish stock through implementation of this framework provision will be beneficial to the fishing communities of the Atlantic coast. By preventing overfishing and allowing stock rebuilding, benefits to the fishing communities will be realized through increased bluefish abundance and subsequent harvests.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Since there is not a minimum mesh imposed initially (measure frameworked to be reviewed annually) with this preferred alternative, there will not be any increase in fishing effort to make up for any foregone catch because of the mesh restrictions. Thus, mesh restrictions will not have any significant impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds. Since this is the first FMP in which the Mid-Atlantic Council is proposing to have mesh regulations for gill nets, gill net fishermen who have never been regulated by this Council may become subject to new regulations. All gill net fishermen should be aware of the gear modification requirements in the Atlantic Large Whale Take Reduction Plan. Since the gill net take reduction technology list varies by area and time, fishermen are encouraged to contact the Regional Administrator to determine regulations that pertain to them.

3.1.4.1.8 *De minimus* specifications

Biological Impacts

This measure will have no direct biological impact because the overall coastwide quota will not change as the result of a *de minimus* status.

Economic Impacts

Under the proposed quota system discussed above (section 3.1.4.1.2), several states would receive less than 0.1% of the coastwide bluefish quota. Assuming a quota of 5.95 million lbs in 1999 (without transfer, section 3.1.4.1.2) and assuming that the states of South Carolina and Georgia are granted *de minimus* status, the state specific shares would be those given in Table 60. Using this example, Georgia would receive an additional 5,387 lbs and South Carolina would receive an additional 3,858 lbs, accounting for an increase in $1,616 and $1,157 in gross revenue from bluefish in the first year, respectively. The effects on the other states would be minimal (i.e., the differences are spread amongst the other 12 states), and their combined gross revenue reduction in the first year would be $2,773.

However, if the recreational sector was not projected to catch their entire allocation of 29.07 million lbs (12,975 mt) in 1999, then the recreational sector could increase landings by up to 10.50 million lbs (4,763 mt) (section 3.1.4.1.2). Assuming that the states of South Carolina and Georgia are granted *de minimus* status, the state specific shares would be those given in Table 60. Using this example, Georgia would receive an additional 9,510 lbs and South Carolina would receive an additional 6,807 lbs, accounting for an increase in $2,853 and $2,042 in gross revenue from bluefish in the first year, respectively. The effects on the other states would be minimal (i.e., the differences are spread amongst the other 12 states), and their combined gross revenue reduction in the first year would be $4,895.

Social Impacts

Allowing qualifying states to claim *de minimus* status would relieve them of an excessive monitoring burden for essentially an incidental fishery. It will also provide them with a small, but more manageable quota.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Since these regulations would not apply to any state that lands less than one-tenth of one percent of commercially caught bluefish, there should not be any significant increase in fishing effort to make up for this small foregone catch. Thus, not regulating any state that has such a small catch of bluefish would not have any significant impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.4.1.9 Recreational harvest limit

Biological Impacts

A recreational harvest limit would be allocated to the recreational fishery to control fishing mortality. The harvest limit would be based on projected stock size estimates for that year as derived from the latest stock assessment information. Estimates of stock size coupled with the target fishing mortality rate would allow for a calculation of total allowable landings. Based on the historic proportions of commercial and recreational landings for 1981 to 1989, 83% of the total allowable landings would be allocated to the recreational fishery.

The base period, 1981 to 1989, was chosen by the Council and Commission as the preferred allocation period because it represents the years prior to the regulations that may have affected both recreational and commercial landings (i.e., prior to the approval of the Bluefish FMP in 1990). Given these considerations, the Council and Commission considered that this period would result in the most fair allocation of the resource.

To assess potential short-term impacts of the allocation, the 1999 TAC projection of 36.84 million lbs (16,710 mt) associated with the preferred stock rebuilding schedule described in section 3.1.4.1.1 were used. The projected yields include commercial landings and recreational catch. As such, an estimate of recreational discards must be subtracted from the TAC to derive a TAL. Discards would be estimated for each year and subtracted from the annual TAC to derive the TAL for that year. Based on 1993 to 1996, the average recreational discard was 1.82 million lbs. After deducting 1999 projected discards of 1.82 million lbs from the 1999 TAC, a TAL of 35.02 million lbs (15,885 mt) is derived (Table 47). The recreational share of the projected TAL for 1999 would be 29.07 million lbs (83% x 35.02 million lbs).

However, under this management alternative, if the recreational sector was not projected to land their entire allocation of 29.07 million lbs in 1999, then the commercial sector could increase landings by up to 10.5 million lbs (4,763 mt). That is, the commercial sector would be allowed to maintain their landings until the recreational sector was able to land their entire allocation. Under this alternative, recreational landings from the prior year would be compared to the proposed harvest limit. If, based on this comparison, the recreational fishery was not anticipated to land their limit, the commercial quota would be set up to 10.50 million lbs (4,763 mt). This is the average commercial landings for the period 1990-1997. However, if the recreational component of the landings was projected to reach the allocation for that year (83%), then the 83/17 allocation would be implemented without transfers.

Recreational landings were 14.74 million lbs in 1996. Since 1981, bluefish recreational landings have generally declined reflecting a drop in availability and/or angler interest. From 1981 to 1996, the percentage of interviewed anglers identifying bluefish as the primary species sought has decreased in the North Atlantic region from 21% to 12%, from 17% to 8% in the Mid-Atlantic region, and from 6% to 2% in the South Atlantic region (MRFSS unpublished data). It is not expected that recreational anglers would substantially increase landings in 1999 versus 1997. As such, the commercial fishery would be allocated up to 10.50 million lbs in 1999.

The adjusted recreational harvest limit for 1999 would be 24.52 million lbs (29.07 million lbs - 4.55 million lbs transferred to the commercial sector). Recreational landings were 14.74 million lbs in 1996. The estimated recreational share under this scenario would actually allow for increased recreational landings relative to 1992-1996, but represents a decrease relative to the years prior to 1991 when landings ranged from 33 to 95 million lbs (Table 23).

This increase in recreational landings associated with the harvest limit is partially due to the fact that the Council and Commission have chosen to allocate the coastwide quota between the recreational and commercial sectors of the fishery based on their respective historical shares of the fishery during the period 1981-1989. Since then the recreational fishery has declined at a faster rate than the commercial fishery resulting in a shift towards the commercial fishery in recent years.

Also, the fact that recreational harvest limits exceed the current recreational landings reflect assessment results that indicate fishing mortality rates are declining and biomass is increasing (see Appendix 1 of this document for the complete assessment). The rebuilding scenarios in this amendment, which are used to determine the recreational harvest limits, are based on the results of a biomass dynamics model and, as such, assume that the productivity of the stock will be the same for the projected years as it was for the years used in that assessment (1974 to 1997). Bluefish are a fast growing, highly fecund fish, and given the right environmental conditions and sufficient spawning stock biomass, the stock could rebuild quickly. If recruitment is lower than anticipated, the stock projections are optimistic. Alternatively, if recruitment is higher than the stock will rebuild at a faster rate.

States could develop and implement alternative recreational management measures that were equivalent to the coastwide measures to achieve the recreational harvest limit. That process is described in section 5.1.4.1.3. For example, Crecco (pers. comm.) determined the conservation equivalency of various combinations of minimum size limits in conjunction with possession limits for bluefish (Table 61). The current size at which bluefish first become vulnerable to recreational fishing mortality is 6.0 in. If the Council and Commission had choose to maintain the current F of 0.4 in 1999, then the creel limit would have to be reduced to 8 fish/day with no minimum size limit or could be increased to 20 fish/day if the size limit were increased to 20 in. (Table 61).

Economic Impacts

The adjusted recreational harvest limit for 1999 would be 24.52 million lbs. This would allow for an increase in recreational landings of 9.78 million lbs (66%) relative to 1996. This may result in an increase in angler satisfaction and benefits in the short-term.

Social Impacts

The proposed recreational harvest limit will allow for the recreational catch to increase from the 1996 level. As such, recreational satisfaction should increase. However, recreational fishermen may consider this alternative unfair since it allows for a higher quota in the commercial fishery. This alternative would allow the commercial fishery to maintain landings up to 10.50 million lbs (average landings for the past 7 years) as long as the recreational sector is not projected to reach 83% of the TAL.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Recreational fisheries, in general, have very limited interactions with marine mammals, sea turtles, shortnose sturgeon, or seabirds as witnessed by the focus of the MMPA on commercial fisheries only. Although the recreational fishery may negatively impact these marine species (section 3.1.4.1.1 for discussion of litter and monofilament line), this alternative will not have an impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.4.1.10 Recreational minimum size limits

Biological Impacts

Historic intercept data can be used as an estimate of potential short-term impacts of length limits on the recreational bluefish fisheries. As an example, the potential short-term effects of a 12" TL minimum size limit in the recreational fishery is used to illustrate the overall analytical process that may be employed to assess consequences of a minimum size limit. The biological, economic and social impacts of this hypothetical minimum size limit are discussed in this section.

The hypothetical minimum size limits would effect recreational landings of bluefish in all states with landings of bluefish. Analysis of 1987-96 intercept data for states from Maine through Florida indicated that 0.2 to 40.7% of the measured bluefish were less than 12" TL (Table 62). On a coastwide basis (Maine to Florida), approximately 21.4% of the bluefish measured were less than 12" TL. Assuming a post-release mortality of 15%, the percent reduction in the number of bluefish killed by anglers associated with a 12" TL minimum size limit would be 18.2% coastwide (Table 63).

The hypothetical minimum size limit could be initially set at 12" TL to protect age 0 bluefish. Based on data from the most recent assessment, age 0 bluefish average 9.1" TL and range from 5.5" to 12.5" TL. Thus a 12" TL minimum size limit will protect virtually all young of the year bluefish.

The assumed level of post-release mortality (hooking and handling mortality) used in the above calculations is based on a study by Malchoff (1995), who estimated the level of post angling catch and release mortality of adult bluefish in New York to be 12.4%. Based on this study and hooking mortality studies conducted for other fish, the Commission Technical Committee assumed a 15%

hooking mortality for bluefish caught by recreational fishermen.

States could develop and implement alternative recreational management measures that were equivalent to the coastwide measures. For example, Crecco (pers. comm.) determined the conservation equivalency (i.e., conservation measures which would result in equivalent levels of SSB/R) of various combinations of minimum size limits in conjunction with possession limits for bluefish relative to a 12" minimum size limit in combinations with a 10 fish possession limit (Table 61). The current size at which bluefish first become vulnerable to recreational fishing mortality is 6.0". If for example, the Council and Commission choose to maintain the current F of 0.4 in 1999, then the creel limit would have to be reduced to 8 fish/day with no minimum size limit or could be increased to 20 fish/day if the size limit were increased to 20 in. (Table 61).

Economic Impacts

Bluefish are important to recreational fisheries of the Atlantic coast of the U.S. During the period 1981 to 1996 bluefish accounted for 29% of the Atlantic coast recreational harvest of finfish by weight, ranging from 42% in 1981 to 11% in 1995 (unpublished MRFSS data). In 1996, bluefish accounted for 12% of the Atlantic coast recreational harvest of finfish by weight.

Since 1981 bluefish landings have generally declined reflecting a drop in availability and/or angler interest. From 1981 to 1996, the percentage of interviewed anglers identifying bluefish as the primary species sought has decreased in the North Atlantic region from 21% to 12%, from 17% to 8% in the Mid-Atlantic region, and from 6% to 2% in the South Atlantic region (MRFSS unpublished data).

At the same time, the number of participants in the marine recreational fisheries of the Atlantic coast has remained relatively constant for the same period (e.g., 4.6 million in 1981 versus 4.8 million in 1996). Furthermore, the total number of fishing trips taken by marine recreational anglers coastwide has increased from 28.3 million in 1981 to 40.1 million in 1996 (MRFSS unpublished data).

Party/charter boats may experience a change in annual gross revenues from the implementation of a minimum size limit. The degree of such change will depend on the decrease in angler's recreational satisfaction which could affect the demand for party/charter boat trips. It is likely that the hypothetical minimum size regulation would result in some decrease in recreational satisfaction. However, there is no indication that this would lead to a decline in the demand for party/charter boat trips coastwide. While the number of bluefish catches has declined over the last decade, the number of fishing trips taken by marine recreational anglers has substantially increased, and the number of participants in the marine recreational fisheries of the Atlantic coast has been relatively unchanged for the same period.

Some of the party/charter boats that operate in the Mid-Atlantic region have historically targeted bluefish. Most of these boats operate in New York and New Jersey. In 1991, the five most frequently caught species in the Mid-Atlantic were spot, bluefish, black sea bass, Atlantic croaker, and summer flounder. While bluefish catches have decreased from 18.4 million fish in 1981 to 5.1 million fish in 1996, the number of individuals participating in marine recreational fishing activities in the Mid-Atlantic region has remained relatively constant (MRFSS unpublished data). The Mid-Atlantic party/charter boats that mainly target bluefish could be affected in the short-term by the implementation of this management action. This will depend on the ability of individual boats to switch to other species such as striped bass, weakfish, etc. However, in the long-term as the status of the stock improves, increase in recreational satisfaction will result in increased net benefits.

The proper management of the bluefish stock through implementation the 12" TL minimum size limit could be beneficial to the recreational fishing communities of the Atlantic coast. In the long-term, increasing the size at entry to the recreational fishery will allow for higher yields from the fishery for a given fishing mortality rate. Increasing yields will result in positive economic benefits to the fishing communities.

Social Impacts

The implementation of the 12" TL minimum size limit may affect fishermen in different ways. This will likely be associated with their previous fishing practices and whether or not they have become accustomed to keeping bluefish less than 12" TL. A recent economic survey conducted by the NMFS (section 2.3.2.2.2) indicates that limits on the minimum size of the fish anglers could keep generated the strongest support among several widely applied regulatory methods. A total of 92.5% and 93.2% of the anglers the New England and Mid-Atlantic regions supporting this measure, respectively.

The impacts of a 12" TL minimum size limit would be more severe on a regional basis, especially in those areas which have a significant "snapper" fishery (a predominantly shore based fishery which targets age 0 and 1 bluefish during the summer and fall). For example, the greatest effect of a 12" TL minimum size limit would occur in the states of Rhode Island, Connecticut, New York, and to a lesser extent, New Jersey. The imposition of a 12" TL minimum size limit would effectively eliminate the "snapper" fisheries in those states. This action will likely have the greatest effect on shore based anglers. This action would also impact the party/charter boat fishery operating in the Mid-Atlantic region. The effect of this management measure on those entities will depend on the ability of these boats to target other species. Party/charter boats can always target several fish species. Nevertheless, if bluefish less than 12" TL continue to be caught, release mortality may become a factor in delaying the recovery of the fishery.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Recreational fisheries, in general, have very limited interactions with marine mammals, sea turtles, shortnose sturgeon, or seabirds as witnessed by the focus of the MMPA on commercial fisheries only. Recreational fishermen do contribute to difficulties for these species of endangered and threatened marine life, in that it is estimated that recreational fishermen discard over 227 million lbs of litter each year (O'Hara *et al.* 1988). More than nine million recreational vessels are registered in the United States. The greatest concentrations of recreational vessels in the United States are found in the waters off New York, New Jersey, the Chesapeake Bay, and Florida (O'Hara *et al.* 1988). Recreational fishermen are also a major source of debris in the form of monofilament fishing line. The amount of fishing line lost or discarded by the 17 million U.S. fishermen during an estimated 72 million fishing trips in 1986 is not known, but if the average angler snares or cuts loose only one yard of line per trip, the potential amount of deadly monofilament line is enough to stretch around the world (O'Hara *et al.* 1988). Although the recreational fishery may impact these marine species, nothing considered in this alternative, relative to the status quo, will have a significant impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.4.1.11 Framework provisions in the recreational fishery

Biological Impacts

Based on a recommendation by the Council and the Commission Policy Board, the Regional Administrator and the states in their respective jurisdictions could modify the possession limit to between 0 and 20 bluefish per angler, the size limit from 6" TL to 23" TL, and open or close the fishing season for any period up to the entire year. Recreational limits would be revised according to specific criteria to account for changes in stock abundance and meet the fishing mortality rate target.

Short-term impacts due to restrictive limits would be outweighed by the long-term benefit of conserving the bluefish stock for future generations of recreational anglers. The possession limit could be as high as 20 bluefish, the size limit decreased to 6" TL, and the season open throughout the year. However, given a constant level of recreational effort, decreases in restrictions would only occur under circumstances of increased bluefish abundance. Since the prevailing rate of fishing success would reflect increased stock abundance, the number of anglers catching their limit would be high for overly restrictive limits. Decreasing recreational restrictions by raising the possession limit, decreasing the size limit, or increasing the length of the fishing season would therefore decrease the number of affected anglers and have less adverse impact than the limit in force at the time.

If stock levels are allowed to continue to decline or the amount of effort by recreational anglers increases (more trips or more people) disproportionately to increases in stock size, landing rates for anglers would decline regardless of specific limits. Adverse impacts would therefore be measured against the prevailing rate of fishing success and would not be as great as when bluefish are abundant or angler effort is less. Although it is not possible to estimate exact impacts for hypothetical levels of bluefish abundance, it is clear that more restrictive limits than those proposed initially would have substantially less impact than a total fishery closure precipitated by stock collapse.

A zero possession limit or a season closed for the entire year would prohibit retention of bluefish by recreational fishermen and would have significant impacts, depending on the level of fishing success currently operative and the value anglers place on retention of catch. These severe restrictions would only be implemented in the event that the stock continues to decline and stock collapse becomes imminent. A 23" TL minimum size, the most restrictive minimum size limit proposed for this framework measure, would have had an associated percent reduction in exploitation of 59.2% based on 1987-1996 coastwide MRFSS data (Table 63). Based on the 1985-1989 data (prior to implementation of bag limits in the bluefish fishery), successful anglers landed between 1 and 250 bluefish per trip (Table 64). The associated percentage reduction in exploitation by anglers ranged from 5.4% for a 20 fish possession limit to 65.5% for a one fish bag limit (Table 65).

Reductions associated with these limits assume 100% compliance by recreational fishermen. Levels of noncompliance will be considered in annual reviews when assessing the impact of bag/size limits on the recreational fishery and determining if modification to the possession/size/season limits are necessary.

Analysis of bluefish recreational data indicated that 88.2% of the annual landings occurred from May through October for the years 1986 to 1995 combined (Table 66). Nearly 71% of the recreational landings occurred between July and October during the same time period. Seasons based on this MRFSS data could be established on a coastwide basis to reduce exploitation. A season could be combined with the size limit to allow for higher possession limits.

Economic Impacts

The overall impact of the implementation of the framework provision would depend on the combination of measures being implemented (e.g., possession limit, size limit, area, and/or season closures) and the geographic area of implementation (e.g., coastwide, single state, etc.). As such, different management measures may affect fishermen in different ways and are likely to vary from region to region. The extent of the impact on the recreational fishery would depend on the number of recreational fishermen targeting bluefish. In general terms the effect of the proposed measure will likely be associated with fishermen previous fishing practices or whether or not they have become accustom to keeping a specific size or number of bluefish.

As an example, in general terms, the implementation of a small size limit will likely affect individuals that target smaller size bluefish. As such, areas where significant "snapper" fishery occurs will likely be affected. On the other hand, the implementation of a large size limit will likely affect individuals that target larger size bluefish. As such, individuals fishing from party/charter boats will likely be affected. The implementation of small possession limits will affect individuals accustomed to keeping large number of bluefish. A zero possession limit or a season closed for the entire year would prohibit retention of bluefish by recreational fishermen and would have significant economic impacts, depending on the level of fishing success currently operative and the value anglers place on retention of catch.

If stock levels are allowed to continue to decline or the amount of effort by recreational anglers increases (more trips or more people) disproportionately to increases in stock size, landing rates for anglers would decline regardless of specific limits. Adverse impacts would therefore be measured against the prevailing rate of fishing success and would not be as great as when bluefish are abundant or angler effort is less. Although it is not possible to estimate exact impacts for hypothetical levels of bluefish abundance, it is clear that more restrictive limits than those proposed initially would have substantially less impact than a total fishery closure precipitated by stock collapse.

Social Impacts

This framework provision is intended to allow for changes in recreational limits, size limits, and season closures to account for changes in stock abundance and meet the targets set forth in the overfishing definition. Recreational fishermen may be affected in different ways. This will depend upon past fishing practices and whether or not they have become accustomed to specific fishing practices (e.g., keeping large number of bluefish, keeping large numbers of small bluefish, etc.). A recent economic survey conducted by the NMFS in the Northeast Region (Maine-Virginia) in 1994, indicated that limits on the minimum size of the fish anglers could keep generated the strongest support by recreational anglers among four widely use fishing regulations (New England = 92.5%, Mid-Atlantic = 93.2%), followed by bag limits (NE=91.1%, MA=88.3%), seasonal closures (NE=78.8%, MA=77.1%), and area closures (NE=67.9%, MA=66.0%).

The impacts of minimum size limit would be more severe on a regional basis. The size limit could range from 6" TL to 23" TL. Smaller size limits would especially affect those areas which have a significant "snapper" fishery (a predominantly shore based fishery which targets age 0 and 1 bluefish during the summer and fall). As such, the implementation of small size limits will likely have the greatest effect on shore based anglers. The effect of such management measures on those individuals will depend on their ability to target other species. The implementation of small possession limits will affect individuals accustomed to keeping large number of bluefish. A zero possession limit or a season closed for the entire year would prohibit retention of bluefish by recreational fishermen and would have significant social impacts, depending on the level of fishing success currently operative and the value anglers place on retention of catch.

The proper management of the bluefish stock through implementation of the framework provision will be beneficial to the fishing communities of the Atlantic coast. By preventing overfishing and allowing stock rebuilding, benefits to the fishing communities will be realized through increased bluefish abundance and subsequent harvests.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Recreational fisheries, in general, have very limited interactions with marine mammals, sea turtles, shortnose sturgeon, or seabirds as witnessed by the focus of the MMPA on commercial fisheries only. Although the recreational fishery may negatively impact these marine species (section 3.1.4.1.1 for discussion of litter and monofilament line), these measures will reduce fishing mortality on bluefish and thus are likely to have a significant impact positive benefit for marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.5 Analysis of the Alternatives to the Preferred Management Measures

3.1.5.1 Take no action at this time

Biological Impacts

With the implementation of this alternative the current regulations would remain unchanged. The no action alternative would not address the problems and objectives identified in sections 1.1.2 and 1.1.3.

However, the current assessment (see Appendix 1) indicates that fishing mortality rates have declined dramatically since 1991. In addition, the assessment indicated that stock biomass has increased steadily from a low of 36.02 million lbs in 1994 to 49.98 million lbs in 1997.

The decline in fishing mortality rates since 1991 is coincident with the implementation of management measures as well as a decline in angler interest for bluefish. The Bluefish FMP was approved in 1990 and fully implemented by the states in 1991. The FMP required a 10 fish possession limit or equivalent recreational measures and also instituted a process to establish commercial quotas. These management measures may have had significant effects on fishing mortality. In addition, MRFSS data for 1991 and 1996 indicate a switch in angler preference from bluefish to striped bass over the time period. For example, in 1991, 34% and 11% of the anglers interviewed identified bluefish and striped bass, respectively, as the primary species sought on their fishing trip. In 1996, the percentages switched with 12% and 44% of the anglers identifying bluefish and striped bass, respectively, as the primary species.

It is possible, if current trends continue, that fishing mortality rates will continue to decline and biomass will continue to increase. As such, the stock could rebuild under the management measures that are currently in place. However, the current plan does not specify target fishing mortality rates and the commercial quota and recreational limits are not linked to specific mortality values. In addition, without specific annual mortality targets, it is uncertain whether or not the stock could rebuild to MSY levels within 10 years. As such, National Standard 1 would not be met.

Economic Impacts

The implementation of this alternative may not reduce overfishing or rebuild the stock. As a result, economic benefits will not accrue in the long-term.

Social Impacts

With the implementation of this alternative, the Council will not address the requirements of the Magnuson-Stevens Act. A sustainable bluefish fishery will not be developed, and negative social and economic impacts may develop if the stock is not rebuilt.

Effects on Marine Mammals, Sea Turtles, and Seabirds

No action may jeopardize the continued existence of the threatened or endangered species mentioned above because there will be uncontrolled, unlimited fishing pressures on the species managed by the FMP. As noted earlier, bluefish may be important in the diets of some seabirds, marine mammals, and various fishes. Since the resource is currently overfished and the biomass is reduced, the availability of bluefish for food for these other populations is also greatly reduced. Preventing overfishing of bluefish thus may be beneficial to some seabirds and certain species of marine mammals.

3.1.5.2 Allocate the annual quota between the recreational and commercial fisheries based on landings for the period 1981-1989

This non-preferred alternative is identical to the preferred commercial quota (3.1.1.8.1) and recreational harvest limit (3.1.1.9.1) alternatives, with the exception that under this non-preferred alternative, the commercial fishery will not received additional allocation in the case that the recreational fishery is not projected to reach 83% of the TAL.

Commercial quota

Biological Impacts

A quota would be allocated to the commercial fishery to control fishing mortality. The quota would be based on stock assessment information on projected stock size estimates for that year. Estimates of stock size coupled with the target fishing mortality rate would allow for a calculation of total allowable landings. Based on the historic proportions of commercial and recreational landings for 1981 to 1989, 17% of the total target would be allocated to the commercial fishery.

To assess potential short-term impacts of the allocation, the 1999 TAC projections of 36.84 million lbs (16,710 mt) associated with the preferred stock rebuilding schedule described in section 3.1.4.1.1 were used. The projected yields include commercial landings and recreational catch. As such, an estimate of recreational discards must be subtracted from the TAC to derive a total allowable landings (TAL). Discards would be estimated for each year and subtracted from the annual TAC to derive the TAL for that year. For 1999, an estimated 1.82 million lbs (825 mt) of discards are deducted from the TAC to yield a TAL of 35.02 million lbs (15,885 mt) (Table 47). This discard level (825 mt) is equal to the average recreational discards for the period 1993 to 1996.

The state-by-state quota system would allow for the most equitable distribution of the commercial quota to fishermen. Specifically, states under this alternative would have the responsibility of managing their quota for the greatest benefit of the commercial bluefish industry in their state. States could design allocation systems based on trip limits and seasons. States would also have the ability to transfer or combine quota increasing the flexibility of the system to respond to year to year variations in fishing practices or landings patterns.

The commercial quota will control mortality on fully recruited, older fish. The ability to close the fishery is a very powerful tool in controlling mortality. Bycatch can be accounted for by closing the directed fishery soon enough to allow for the bycatch and, to the extent the quota is exceeded, by appropriately reducing the next year's quota. This combination seems to be the most reasonable compromise between stopping all fishing that may result in additional bluefish mortality and allowing fishing to continue and making all adjustments in the subsequent year's quota. Since bluefish may only be sold by an individual possessing a commercial bluefish permit, the bluefish bycatch will be accounted for by the reporting system.

Combined, the minimum mesh, minimum fish size regulation, and the commercial quota will prevent overfishing and reduce waste in the commercial sector. The commercial quota will be based on the commercial share (17%) of a total quota which under average or above average conditions would be equal to landings associated with F's associated with the preferred stock rebuilding schedule described in section 3.1.4.1.1.

Economic Impacts

The commercial share of the projected TAL for 1999 would be 5.95 million lbs (17% x 35.02 million lbs). This represents a decrease in commercial landings of 3.29 million lbs (36%) relative to 1996.

The effect of the overall bluefish exvessel price given the potential decrease in landings from the implementation of the proposed quota would depend on the elasticity of demand for bluefish. Since no study has estimated the exvessel demand function for bluefish, revenue changes from the implementation of the new quota were calculated by taking exvessel price (value divided by lbs) for 1996 and multiplying this value by the potential change in landings. Assuming the 1996 exvessel price of $0.30 per pound, the 1999 quota may potentially yield a decrease in revenues of $987,000 from the 1996 period. Assuming that this represents the initial decrease in annual revenues for all participants in the fishery, and that it is evenly distributed over all participants in the fishery (2487 vessels that landed bluefish in 1996), each business unit would lose on average $397. However, it is possible that the decrease in landings will result in an increase in exvessel price per pound, thereby mitigating some of the potential loss in revenues.

When compared to the scenario that allows the commercial fishery to increase landings by up to 10.50 million lbs (section 3.1.4.1.5), this non-preferred alternative would result in a loss of revenues of $1,350,000 ($987,000 + $363,000) to the commercial fishery. Assuming that this represents the initial decrease in annual revenues for all participants in the fishery, and that it is evenly distributed over all participants in the fishery (2487 vessels that landed bluefish in 1996), each business unit would lose on average $543.

Social Impacts

The proposed commercial quota will reduce the commercial catch. If commercial fishermen can substitute the potential income loss by landing another species without additional effort, they may see no negative impact. However, if substitution is not available, fishermen may find it necessary to make changes within the business operation to replace lost income. This could in turn have short-term impacts. Nevertheless, given the analysis conducted above, it is not anticipated that commercial fishermen will be faced with substantial income loss in the shot-term. Furthermore, it is expected that the commercial quota combined with other management actions (e.g., minimum mesh, minimum fish size regulation) will prevent overfishing and reduce waste in the commercial sector. This will in turn increase benefits in the commercial fishery in the long-term.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Because the quota will reduce commercial landings, contacts with endangered and threatened sea turtles, shortnose sturgeon, seabirds, and marine mammals should be reduced.

Recreational harvest limit

Biological Impacts

A recreational harvest limit would be allocated to the recreational fishery to control fishing mortality. The harvest limit would be based on projected stock size estimates for that year as derived from the latest stock assessment information. Estimates of stock size coupled with the target fishing mortality rate would allow for a calculation of total allowable landings. Based on the historic proportions of commercial and recreational landings for 1981 to 1989, 83% of the total allowable landings would be allocated to the recreational fishery.

To assess potential short-term impacts of the allocation, the 1999 TAC projection of 36.84 million lbs (16,710 mt) associated with the preferred stock rebuilding schedule described in section 3.1.4.1.1 was used. The projected yields include commercial landings and recreational catch. As such, an estimate of recreational discards must be subtracted from the TAC to derive a TAL. Discards would be estimated for each year and subtracted from the annual TAC to derive the TAL for that year. Based on 1993 to 1996, the average recreational discards was 1.82 million lbs. After deducting 1999 projected discards of 1.82 million lbs from the 1999 TAC, a TAL of 35.02 million lbs (15,885 mt) is derived (Table 47). The recreational share of the projected TAL for 1999 would be 29.07 million lbs (83% x 35.02 million lbs). Recreational landings were 14.74 million lbs in 1996. The estimated recreational share under this scenario would actually allow for increased recreational landings relative to 1992-1996, but represents a decrease relative to the years prior to 1991 when landings ranged from 33 to 95 million lbs (Table 23).

This increase in recreational landings associated with the harvest limit is partially due to the fact that the Council and Commission have chosen to allocate the coastwide quota between the recreational and commercial sectors of the fishery based on their respective historical shares of the fishery during the period 1981-1989. Since then, the recreational fishery has declined at a faster rate than the commercial fishery resulting in a shift towards the commercial fishery in recent years.

Also, the fact that recreational harvest limits exceed the current recreational landings reflect assessment results that indicate fishing mortality rates are declining and biomass is increasing (see Appendix 1 of this document for the complete assessment). The rebuilding scenarios in this amendment, which are used to determine the recreational harvest limits, are based on the results of a biomass dynamics model and, as such, assume that the productivity of the stock will be the same for the projected years as it was for the years used in that assessment (1974 to 1997). Bluefish are a fast growing, highly fecund fish and given the right environmental conditions and sufficient spawning stock biomass, the stock could rebuild quickly. If recruitment is lower than anticipated, the stock projections are optimistic. Alternatively, if recruitment is higher, the stock will rebuild at a faster rate.

States could develop and implement alternative recreational management measures that were equivalent to the coastwide measures to achieve the recreational harvest limit. That process is described in section 5.1.4.1.3. Crecco (pers. comm.) determined the conservation equivalency of various combinations of minimum size limits in conjunction with possession limits for bluefish (Table 61). The current size at which bluefish first become vulnerable to recreational fishing mortality is 6.0 in. If the Council and Commission choose to maintain the current F of 0.4 in 1999, then the creel limit would have to be reduced to 8 fish/day with no minimum size limit or could be increased to 20 fish/day if the size limit were increased to 20 in. (Table 61).

Economic Impacts

The recreational share of the proposed TAL for 1999 would be 29.07 million lbs (83% x 35.02 million lbs). This would allow for an increase in recreational landings of 14.33 million lbs (97%) relative to 1996. This may result in an increase in angler satisfaction and benefits in the short-term.

When compared to the scenario that allows the commercial fishery to increase landings by up to 10.50 million lbs (4,763 mt) (section 3.1.4.1.9), this non-preferred alternative would provide greater recreational landings for 1999 of 29.07 million lbs. This may result in an increase in angler satisfaction and benefits in the short-term.

Social Impacts

The proposed recreational harvest limit will allow for the recreational catch to increase from the 1996 level. As such, recreational satisfaction should increase.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Recreational fisheries, in general, have very limited interactions with marine mammals, sea turtles, shortnose sturgeon, or seabirds as witnessed by the focus of the MMPA on commercial fisheries only. Although the recreational fishery may negatively impact these marine species (section 3.1.4.1.1 for discussion of litter and monofilament line), this alternative will not have an impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.5.3 Allocate the annual quota between the recreational and commercial fisheries based on landings for the period 1981-1993

Biological Impacts

The biological impacts would be the same as those identified in the sections describing the commercial quota and the recreational harvest limit in section 3.1.5.2 above.

Economic Impacts

The commercial quota specified by the FMP monitoring committee under this alternative would be 19.1%, and the recreational harvest limit would be 80.9% of the annual quota specified for the upcoming year. When these percentages are compared to the recreational and commercial distributions under the non-preferred commercial quota and recreational harvest limit allocations (section 3.1.5.2), the recreational sector would lose 2.1% of the total annual quota, and the commercial sector would gain 2.1% of the total annual quota.

Using the same assumptions employed to analyze the non-preferred commercial quota alternative (section 3.1.5.2), the commercial share of the projected TAL for 1999 would be 6.69 million lbs (19.1% x 35.02 million lbs). This would allow the commercial sector to increase its share of the total allocation by an additional 740,000 lbs ($222,000) compared to the non-preferred commercial quota alternative discussed in section 3.1.5.2.

When compared to the scenario that allows the commercial fishery to increase landings by up to 10.50 million lbs (section 3.1.4.1.5), this non-preferred alternative would result in a loss of revenues of $141,000 ($363,000 - $222,000) to the commercial fishery. Assuming that this represents the initial decrease in annual revenues for all participants in the fishery, and that it is evenly distributed over all participants in the fishery (2487 vessels that landed bluefish in 1996), each business unit would lose on average $57.

Using the same assumptions employed to analyze the non-preferred recreational harvest limit alternative (section 3.1.5.2), the recreational share of the projected TAL for 1999 would be 28.33 million lbs (80.9% x 35.02 million lbs). Adjusted recreational landings for 1999 would be 23.78 million lbs (28.33 million lbs - 4.55 million lbs). This scenario would allow for an increase in recreational landings of 9.05 million lbs (61%) relative to 1996.

When compared to the scenario that allows the commercial fishery to increase landings by up to 10.50 million lbs (section 3.1.4.1.9), this non-preferred alternative would result in a reduction in recreational landings of 0.74 million lbs (24.52 million lbs - 23.78 million lbs).

Social Impacts

The bluefish fishery will be managed via a quota setting process specified in 3.1.1.6. Under this alternative, the annual quota would be allocated to the commercial and recreational sectors of the fishery based on their respective percentage share of landings for the period 1981-1993 (Table 23).

With the implementation of this alternative, the commercial quota would be 19.1%, and the recreational harvest limit would be 80.9% of the annual quota specified for the upcoming year. This allocation would include more recent landings data which may reflect more current fishing practices. However, it also includes years in which recreational and commercial fishermen and their landings were affected by regulations. As such, recreational fishermen may consider this an unfair allocation.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Because the quota will increase commercial landings, contacts with endangered and threatened sea turtles, shortnose sturgeon, seabirds, and marine mammals should increase. In general, recreational fisheries have very limited interactions with marine mammals, sea turtles, shortnose sturgeon, or seabirds as witnessed by the focus of the MMPA on commercial fisheries only. Although the recreational fishery may negatively impact these marine species (section 3.1.4.1.1 for discussion of litter and monofilament line), this alternative will not have an impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.5.4 Allocate the annual quota between the recreational and commercial fisheries based on landings for the period 1985-1989

Biological Impacts

The biological impacts would be the same as those identified in the sections describing the non-preferred commercial quota and recreational harvest limit in 3.1.5.2 above.

Economic Impacts

The commercial quota specified by the FMP monitoring committee under this alternative would be 18.2%, and the recreational harvest limit would be 81.8% of the annual quota specified for the upcoming year. When these percentages are compared to the recreational and commercial distributions under the non-preferred commercial quota and recreational harvest limit (section 3.1.5.2), the recreational sector would lose 1.2% of the total annual quota, and the commercial sector would gain 1.2% of the total annual quota.

Using the same assumptions employed to analyze the non-preferred commercial quota alternative (section 3.1.5.2), the commercial share of the projected TAL for 1999 would be 6.37 million lbs (18.2% x 35.02 million lbs). This would allow the commercial sector to increase its share of the total allocation by an additional 420,000 lbs ($126,000) compared to the non-preferred alternative discussed in section 3.1.5.2.

When compared to the scenario that allows the commercial fishery to increase landings by up to 10.50 million lbs (section 3.1.4.1.5), this non-preferred alternative would result in a loss of revenues of $57,000 ($420,000 - 363,000) to the commercial fishery. Assuming that this represents the initial decrease in annual revenues for all participants in the fishery, and that it is evenly distributed over all participants in the fishery (2487 vessels that landed bluefish in 1996), each business unit would lose on average $23.

Using the same assumptions employed to analyze the non-preferred recreational harvest limit alternative (section 3.1.5.2), the recreational share of the projected TAL for 1999 would be 28.65 million lbs (81.8% x 35.02 million lbs). This would represent a decrease of 0.42 million lbs compared to the recreational harvest limit under the preferred alternative.

When compared to the scenario that allows the commercial fishery to increase landings by up to 10.50 million lbs (section 3.1.4.1.9), this non-preferred alternative would result in an increase in recreational landings of 0.42 million lbs (29.07 million lbs - 28.65 million lbs).

Social Impacts

The bluefish fishery will be managed via a quota setting process specified in 3.1.1.6. Under this alternative, the annual quota would be allocated to the commercial and recreational sectors of the fishery based on their respective percentage share of landings for the period 1985-1989 (Table 23).

With the implementation of this alternative, the commercial quota would be 18.2% and the recreational harvest limit would be 81.8% of the annual quota specified for the upcoming year. This allocation would be based on a more limited number of years and would not reflect the amount of annual variability in the catch by area and season that is captured in the preferred alternative. This, in turn, could lead to an unfair allocation relative to the preferred alternative.

Effects on Marine Mammals, Sea Turtles and Sea Birds

Because the quota will increase commercial landings, contacts with endangered and threatened sea turtles, shortnose sturgeon, seabirds, and marine mammals should increase. Recreational fisheries, in general, have very limited interactions with marine mammals, sea turtles, shortnose sturgeon, or seabirds as witnessed by the focus of the MMPA on commercial fisheries only. Although the recreational fishery may negatively impact these marine species (section 3.1.4.1.1 for discussion of litter and monofilament line), this alternative will not have an impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.5.5 Implement a state-by-state commercial quota system with allocations based on landings from 1981-1993

Biological Impacts

The biological impacts would be the same as those identified in the section describing the commercial quota (3.1.5.2). The state shares would change because of the use of different base years.

Economic Impacts

The overall economic impacts are similar to those identified in the section describing the commercial quota (3.1.5.2).

The main difference between this alternative and the alternatives described in sections 3.1.4.1.5 and 3.1.5.2 is the base period employed to allocate the quota among the states. In this alternative, the state shares are based on landings for the 1981 to 1993 time period, while in the preferred alternative, the state shares are based on landings for the 1981 to 1989 time period. If this alternative was implemented, commercial bluefish shares would decrease in eight states (Maine, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida) when compared to the preferred alternative, ranging from 0.002% in Georgia to 1.8% in Virginia (Table 67, Column D). At the same time, commercial bluefish shares would increase in six states (New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, and New Jersey) when compared to the preferred alternative, ranging from 0.08% in Massachusetts to 1.2% in Rhode Island (Table 67, Column D).

Social Impacts

The overall social impacts are similar to those identified in the section describing the commercial quota (3.1.5.2).

Effects on Marine Mammals, Sea Turtles, and Seabirds

The state-by-state commercial quota options considered in this amendment would not have any significant impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.5.6 Implement a state-by-state commercial quota system with allocations based on landings from 1985-1989

Biological Impacts

The biological impacts would be the same as those identified in the section describing the commercial quota (3.1.5.2).

Economic Impacts

The overall economic impacts are similar to those identified in the sections describing the commercial quota (3.1.5.2),

The main difference between this alternative and the alternatives described in sections 3.1.4.1.5 and 3.1.5.2 is the base period employed to allocate the quota among the states. In this alternative, the state shares are based on landings for the 1985 to 1989 time period, while in the preferred alternative, the state shares are based on landings for the 1981 to 1989 time period. If this alternative was implemented, commercial bluefish shares would decrease in six states (Maine, Connecticut, New York, Delaware, Virginia, North Carolina, South Carolina, and Florida) when compared to the preferred alternative, ranging from 0.007% in South Carolina to 3.1% in North Carolina (Table 67, Column E). At the same time, commercial bluefish shares would increase in six states (New Hampshire, Massachusetts, Rhode Island, New Jersey, Maryland, and Georgia) when compared to the preferred alternative, ranging from 0.003% in Georgia to 2.3% in New Jersey (Table 67, Column E).

Social Impacts

The overall social impacts are similar to those identified in the sections describing the commercial quota (3.1.5.2).

Effects on Marine Mammals, Sea Turtles, and Seabirds

The state-by-state commercial quota options considered in this amendment would not have any significant impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.5.7 Implement a coastwide trip limit system in conjunction with a state by state quota system

Biological Impacts

The biological impacts would be the same as those identified in the sections describing the commercial quota (3.1.5.2).

Economic Impacts

The bluefish FMP currently states that the coastwide commercial quota be allocated to the states based on the average percentage of coastwide commercial landings from the most recent ten year period. Each state is responsible for administering their commercial quota in their state. Individual states may establish trip limits and seasons to insure that their annual quota is not exceeded. Under this alternative, the states would be required to implement a uniform trip limit which would apply coastwide. A coastwide uniform trip limit system will not likely ensure equitable distribution for all areas, gears, and seasons.

Social Impacts

The advantage of this alternative is that a uniform trip limit would be relatively easy to enforce because all individuals would be subject to the same trip limit regardless of state of origin or location of fishing. The drawback to this alternative is that a uniform trip limit would not be appropriate for all areas, gears, and seasons. In addition, states with small quota allocations could have their quotas filled relatively quickly compared to states with larger allocations if a uniform coastwide trip limit were in effect.

Effects on Marine Mammals, Sea Turtles, and Seabirds

The trip limit options considered in this amendment would not have any significant impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.5.8. Commercial maximum fish size limit

Biological Impacts

Historic commercial length frequencies were used as an estimate of potential short-term impacts of maximum length limits on the commercial bluefish fisheries (Table 68). Specifically, commercial length frequencies from the NMFS Weighout Data were used to determine potential maximum size limit effects.

Based on NMFS weighout data for 1987-1996, approximately 23.2% of the measured bluefish were greater than 28" TL for all gears with sampled landings (Table 68). During the same time frame, no bluefish greater than 36" TL were measured while 45.7% were greater than 20" TL based on the NMFS weighout data.

Maximum size regulations could have positive impacts on the stock. Maximum size regulations can increase spawning stock biomass by allowing more large, highly fecund fish to spawn.

Economic Impacts

The economic impact on the commercial sector from the implementation of this alternative will vary between regions and gears employed. In general terms, the reduction in revenues in the short-term are expected to be more significant for small maximum size limits.

Social Impacts

The proposed commercial maximum fish size limitation will reduce the commercial catch. If commercial fishermen can substitute the potential income loss by landing another species without additional effort, they may see no negative impact. However, if this is not possible short-term impacts could occur. Nevertheless, given the analysis conducted under economic impacts above, it is anticipated that commercial fishermen could be faced with some income loss.

Effects on Marine Mammals, Sea Turtles, and Seabirds

A maximum fish size for bluefish could increase spawning potential possible increasing the availability of small bluefish as food for marine mammals and birds.

3.1.5.9 Quarterly coastwide commercial quota

Biological Impacts

The biological impacts would be the same as those identified in the section describing the commercial quota (3.1.5.2).

Economic Impacts

The overall economic impacts are similar to those identified in the section describing the commercial quota (3.1.5.2). However, a quarterly quota system could allow for an equitable allocation of the commercial quota to northern and southern participants as well as between the smaller day boats and larger offshore vessels. Due to the seasonal nature of the bluefish fishery, the quota would have to be divided into quarterly units. To minimize effects on traditional landings patterns, the allocation to each period would be based on past landings instead of a system that divided the quota equally over the four periods. It is expected that the quarterly allocations would allow fishermen to maintain traditional landings patterns in most states.

Social Impacts

A coastwide system would allow fishermen to land in any port along the coast, and all commercial landings during a quarterly period would count toward that quota for that period. When the quota had been landed for a quarterly period, fishing for and/or landing bluefish would be prohibited for the remainder of the period. Landings in excess of the allocation for the period would be subtracted from the following years's quota for the same period. Trip limits would have to be implemented. Quarterly allocations without trip limits would encourage derby-style fishing practices that would allow the quota to be landed by larger, more mobile vessels at the beginning of each period. As a result, supplies of bluefish would be discontinuous, and smaller boats would be disadvantaged.

Different trip limit systems could be designed for each period to ensure equitable distribution over each three-month period. Unlike a system where states have the flexibility to design their own systems, NMFS would be responsible for implementing trip limits for each period. However, such a system would place a large administrative burden on NMFS at a time when additional resources are not available.

The implementation of trip limits would discourage derby-style fishing practices that would allow the quota to be landed by larger, more mobile vessels at the beginning of each period. This would allow for supplies of bluefish to be continuous throughout the entire quarter. Furthermore, smaller boats would not be disadvantaged.

3.1.5.10 Licensing individuals in the commercial and party/charter fisheries

Biological Impacts

The current FMP requires that *individuals* possess a commercial license to sell bluefish. There are no direct biological impacts associated with the implementation of this alternative. However, under this alternative, the monitoring of the quota system could potentially be undermined because it may be difficult to contact specific individuals with timely notifications or quota reports.

Economic Impacts

The current FMP requires that *individuals* possess a commercial license to sell bluefish. There are no direct economic impacts associated with the implementation of this alternative. However, the implementation and enforcement of commercial closures and commercial minimum fish sizes under this alternative would likely be more complicated and costly than under the preferred alternative. Furthermore, reporting requirements for individuals possessing a commercial license to sell bluefish and administrative costs associated with various reporting requirements would also be higher under this alternative due to the higher number of entities or individuals that would need to report.

Social Impacts

The current FMP requires that *individuals* possess a commercial license to sell bluefish. Virtually every other federal FMP currently in effect in the Northeast region of the U.S. requires that the vessel be licensed. The benefit of vessel permits is that the harvest capacity or fishing power of the fleet can be determined and controlled when the vessel is licensed rather than the individual. Under the current system of licensing the individual, the individual can fish from any vessel or platform without limit to size or horsepower. Under this system, the degree of capitalization of the fleet cannot be determined. If the vessels were licensed, the degree to which capitalization and fishing power of the fleet need to be regulated could be more clearly evaluated.

Effects on Marine Mammals, Sea Turtles, and Seabirds

The individual permits will not have any significant impact on marine mammals, sea turtles, shortnose sturgeon, and seabirds.

3.1.5.11 Alternative rebuilding schedules

3.1.5.11.1 Reduction in fishing mortality by 75% over a five year period (1999 to 2003) to rebuild to biomass target (B_{MSY})

Biological Impacts

The stock rebuilding strategy associated with this step reduction action would last 5 years. Table 51 details the schedule for this recovery strategy.

Under this recovery strategy, projected yields would decrease during the first year of the recovery period from 30.42 million lbs (13,800 mt) in 1999 to 26.08 million lbs (11,830 mt) in year 2000. Then the TAC is projected to slowly increase to 36.46 million lbs (16,540 mt) during the last year of the recovery period (Table 51).

Based on the proposed TAC under this strategy and discards estimates of 1.82 million lbs (825 mt) in 1999, the recreational fishery would receive a recreational harvest limit of 23.74 million lbs (10,769 mt), and the commercial fishery would receive a quota of 4.86 million lbs (2,206 mt).

Economic Impacts

This alternative will achieve the biomass target in 5 years. The proposed recovery schedule would result in smaller projected TACs for most of the recovery period versus the preferred alternative.

The projected commercial quota for 1999 would be 4.86 million lbs (17% x 28.60 million lbs). This represents a decrease in commercial landings of 4.43 million lbs (48%) relative to 1996. Employing the same assumptions used to analyze the preferred rebuilding schedule described in section 3.1.4.1.1, it is expected that this reduction in landings would result is a decrease in revenues of $1.3 million from the 1996 period. The projected recreational landings for 1999 would be 23.74 million lbs (83% x 28.60 million lbs). This would allow for an increase in recreational landings of 8.33 million lbs (57%) relative to 1996. This may result in an increase in angler satisfaction and benefits in the short-term.

Social Impacts

The proposed rebuilding schedule will achieve the total biomass target in 5 years. While this recovery schedule will achieve B_{MSY} in a shorter time period than the preferred alternative, there is a decline in the projected TACs for most of the recovery schedule. It is expected that greater negative social impacts for the commercial sector will occur under this alternative compared to the preferred option in the short-term.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Similar impacts to those described in section 3.1.4.1.1.

3.1.5.11.2 Constant harvest strategy throughout the entire recovery period until the stock is recovered

Biological Impacts

The stock rebuilding strategy associated with this constant harvest strategy would last 6 years. Fishing mortality would be reduced as follows if a constant harvest of 14,500 mt (32 million lbs) is maintained for 6 years: $F_{1999}=0.46$, $F_{2000}=0.35$, $F_{2001}=0.35$, $F_{2002}=0.25$, $F_{2003}=0.18$, and $F_{2004}=0.10$. Total bluefish biomass would reach B_{MSY} during the sixth year of the rebuilding program. Table 52 details the schedule for accomplishing this recovery strategy.

Projection of stock biomass suggests that the bluefish stock can recover to sustainable biomass by maintaining a constant harvest of 32 million lbs (14,500 mt) in approximately 6 years. Under this recovery strategy, landings would be held constant over the recovery period. Overall, yield from the fishery under the constant harvest policy would be much lower compared to the preferred alternative.

Based on the proposed TAC under this strategy and discards estimates of 1.82 million lbs (825 mt) in 1999, the recreational fishery would receive a recreational harvest limit of 25.05 million lbs (11,363 mt), and the commercial fishery would receive a quota of 5.13 million lbs (2,237 mt).

Economic Impacts

This alternative will achieve the biomass target in 6 years. The proposed constant harvest strategy would result in lower cumulative yields during the first 6 years compared to the preferred alternative. As a result, this alternative is expected to result in short-term adverse effects.

Under this alternative, the projected commercial quota for 1999 would be 5.13 million lbs (17% x 30.18 million lbs). This represents a decrease in commercial landings of 4.16 million lbs (46%) relative to 1996. Employing the same assumptions used to analyze the preferred rebuilding schedule described in section 3.1.4.1.1, it is expected that this reduction in landings would result is a decrease in revenues of $1.2 million from the 1996 period. The projected recreational landings for 1999 would be 25.05 million lbs (83% x 30.18 million lbs). This would allow for an increase in recreational landings of 10.29 million lbs (70%) relative to 1996. This may result in an increase in angler satisfaction and benefits in the short-term.

Social Impacts

The proposed rebuilding schedule will achieve the total biomass target in 6 years. While this recovery schedule will achieve B_{MSY} in a shorter time period than the preferred alternative, projected TACs during the recovery period are lower than those from the preferred schedule. It is expected that greater negative social impacts for the commercial sector will occur under this alternative compared to the preferred option in the short-term.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Similar impacts to those described in section 3.1.4.1.1.

3.1.5.11.3 Constant fishing mortality (F=0.23) over a five year period (1999 to 2003) to rebuild to biomass target (B_{MSY})

Biological Impacts

The stock rebuilding strategy associated with this action would last 5 years. Total bluefish biomass would reach B_{MSY} in 5 years. Table 53 details the schedule for accomplishing this recovery strategy.

Projection of stock biomass suggests that the bluefish stock can recover to sustainable biomass by setting fishing mortality constant at F=0.23.

Based on the proposed TAC under this strategy and discards estimates of 1.82 million lbs in 1999, the recreational fishery would receive a recreational harvest limit of 14.38 million lbs (6,525 mt), and the commercial fishery would receive a quota of 2.95 million lbs (1,336 mt).

Economic Impacts

This alternative will achieve biomass targets in 5 years. The proposed recovery schedule would result in increasing projected yields throughout the entire recovery period. However, the proposed decrease in fishing mortality under this alternative will result in grater decreases in projected yields than the preferred alternative, especially during the first several years of the recovery years.

The projected commercial quota for 1999 would be 2.95 million lbs (17% x 17.33 million lbs). This represents a decrease in commercial landings of 6.34 million lbs (68%) relative to 1996. Employing the same assumptions used to analyze the preferred rebuilding schedule described in section 3.1.4.1.1, it is expected that this reduction in landings would result is a decrease in revenues of $1.9 million from the 1996 period. The projected recreational landings for 1999 would be 14.38 million lbs (83% x 17.33 million lbs). This would result in a decrease in recreational landings of 0.36 million lbs (2%) relative to 1996. This may result in an increase in angler satisfaction and benefits in the short-term.

Social Impacts

The proposed rebuilding schedule will achieve the total biomass target in 5 years. This recovery schedule will achieve B_{MSY} in a shorter time period than the preferred alternative. Projected yields associated with this recovery schedule will increase throughout the entire recovery period from 19.15 million lbs in 1999 to 60.63 million lbs in 2003. However, given the small yield projections at the beginning of the recovery period, it would be expected that this option would have greater negative impacts compared to the preferred option.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Similar impacts to those described in section 3.1.4.1.1.

3.1.5.11.4 Constant fishing mortality (F=0.36) over a nine year period (1999 to 2007) to rebuild to biomass target (B_{MSY})

Biological Impacts

The stock rebuilding strategy associated with this action would last 9 years. Total bluefish biomass would reach B_{MSY} in 5 years. Table 54 details the schedule for accomplishing this recovery strategy.

Based on the proposed TAC under this strategy and discards estimates of 1.82 million lbs in 1999, the recreational fishery would receive a recreational harvest limit of 21.62 million lbs (9,807 mt), and the commercial fishery would receive a quota of 4.43 million lbs (2,009 mt).

Economic Impacts

This alternative will achieve biomass targets in 9 years. The proposed recovery schedule would result in increasing projected yields throughout the entire recovery period. However, the proposed decrease in fishing mortality under this alternative will result in grater increase in projected yields than the preferred alternative, especially during the first several years of the recovery years.

The projected commercial quota for 1999 would be 4.43 million lbs (17% x 26.05 million lbs). This represents a decrease in commercial landings of 4.86 million lbs (52%) relative to 1996. Employing the same assumptions used to analyze the preferred rebuilding schedule described in section 3.1.4.1.1, it is expected that this reduction in landings would result is a decrease in revenues of $1.5 million from the 1996 period. The projected recreational landings for 1999 would be 21.62 million lbs (83% x 26.05 million lbs). This would result in an increase in recreational landings of 6.89 million lbs (47%) relative to 1996. This may result in an increase in angler satisfaction and benefits in the short-term.

Social Impacts

The proposed rebuilding schedule will achieve the total biomass target in 9 years. This recovery schedule will achieve B_{MSY} in the same time period as the preferred alternative. Projected yields associated with this recovery schedule will increase throughout the entire recovery period from 27.87 million lbs in 1999 to 91.23 million lbs in 2003. However, given the small yield projections at the beginning of the recovery period, it would be expected that this option would have greater negative impacts in the short-term compared to the preferred option.

Effects on Marine Mammals, Sea Turtles, and Seabirds

Similar impacts to those described in section 3.1.4.1.1.

4.0 REGULATORY IMPACT REVIEW AND REGULATORY FLEXIBILITY ANALYSIS

4.1 INTRODUCTION

The National Marine Fisheries Service (NMFS) requires the preparation of a Regulatory Impact

Review (RIR) for all regulatory actions that either implement a new Fishery Management Plan (FMP) or significantly amend an existing plan. The RIR is prepared by the Regional Fishery Management Councils with assistance from the National Marine Fisheries Service (NMFS), as necessary. The RIR is part of the process of preparing and reviewing FMPs and provides a comprehensive review of the level and incidence of economic impact associated with proposed regulatory actions. The analysis also provides a review of the problems and policy objectives prompting the regulatory proposals and an evaluation of the major alternatives that could be used to solve the problems. The purpose of the analysis is to ensure that the regulatory agency systematically and comprehensively considers all available alternatives so that the public welfare can be enhanced in the most efficient and cost-effective way.

The National Marine Fisheries Service requires a RIR for all regulatory actions that are part of public interest. The RIR does three things: 1) it provides a comprehensive review of the level and incidence of impacts associated with a proposed or final regulatory action; 2) it provides a review of the problems and policy objectives prompting the regulatory proposals and an evaluation of the major alternatives that could be used to the problem; and 3) it ensures that the regulatory agency systematically and comprehensively considers all available alternatives so public welfare can be enhanced in the most efficient and cost effective way.

The RIR addresses many items in the regulatory philosophy and principles of Executive Order (E.O.) 12866. The RIR also serves as the basis for determining whether any proposed regulation is a "significant regulatory action" under certain criteria provided in E.O. 12866 and whether the proposed regulations will have a significant economic impact on a substantial number of small entities in compliance with Regulatory Flexibility Act of 1980 (RFA) as amended by Public Law 104-121. The purpose of the RFA is to relieve small businesses, small organizations, and small government entities from burdensome regulations and recordkeeping requirements, to the extent possible.

4.2 PROBLEMS AND OBJECTIVES

The description of the bluefish fishery can be found in section 2.0 of this amendment. The problems for resolution and management objectives are outlined in sections 1.1.2 and 1.1.3 of this amendment, respectively.

4.3 METHODOLOGY AND FRAMEWORK FOR ANALYSIS

The basic approach adopted in this RIR is an assessment of management measures from the standpoint of determining the resulting changes in costs and benefits to society. The net effects should be stated in terms of producer and consumer surpluses for the harvesting, processing/dealer sectors, and for consumers. Ideally, the expected present values of net yield streams over time associated with different alternatives should be compared in evaluating the impacts. However, lack of data precludes this type of analysis. The approach taken in analyzing the alternative management actions is to describe and/or quantify to the extent possible the changes in net benefits.

4.4 IMPACTS OF THE PREFERRED ACTIONS AND ALTERNATIVES TO THE AMENDMENT

The proposed management actions and the alternative management actions in this amendment were discussed in the integrated portion of this document (section 3.1) and are summarized below.

4.4.1 Summary of Impacts of Preferred Actions

Amendment 1 would require: 1) a stock rebuilding schedule; 2) permits for commercial and party/charter vessels; 3) dealer permits; 4) operator permits; 5) commercial quota; 6) commercial minimum fish size (framework provision); 7) mesh size regulation (framework provision); 8) *de minimus* specifications; 9) recreational harvest limit; 10) recreational size limit (framework provision); and 11) other framework provisions in the recreational fishery. The purpose of this summary is to briefly describe the expected economic impacts of the preferred actions considered in this amendment.

The first management alternative is expected to rebuild the bluefish stock while reducing fishing mortality in 9 years. This recovery schedule would rebuild the stock while complying with the requirements of the Sustainable Fisheries Act. In 1999, commercial landings would be reduced by 3.29 million lbs ($987,000) relative to 1996. Projected recreational landings would increase in 1999 by 8.33 million lbs relative to 1996. This rebuilding strategy provides the smallest decrease in revenues for the commercial sector in 1999 compared to 1996. The preferred rebuilding schedule will achieve biomass target in the shortest time period while providing stability in projected yields during the recovery period. The short-term results discussed above will occur if the recreational fishery is allocated the full 83% of the TAL. However, if the commercial sector is allow to maintain its landings up to 10.5 million lbs, results will then be identical as those discussed under the preferred quota alternative (alternative 5 in this section) and preferred recreational harvest limit alternative (alternative 9 in this section).

Alternatives two through four require the implementation of permit requirements for commercial and party/charter vessels, dealers, and operators. Given the current condition of the stock, as well as popularity of bluefish in the recreational sector, a comprehensive system which accounts for all activities in the fishery is necessary to enforce provisions of the amendment and prevent overfishing. Permits issued to all entities which harvest or sell bluefish provide the foundation of this accounting system, as well as a strong tool for enforcement since permits can be revoked for violations of the amendment.

It is estimated that 2,487 commercial vessels landed bluefish in 1996 along the Atlantic coast. Under the alternative requiring commercial vessel permits, any owner of a vessel desiring to fish commercially for bluefish must obtain a federal vessel permit or a state commercial permit. It is estimated that about 90% of the vessels currently fishing for bluefish commercially already hold a valid NMFS permit for one or more additional fisheries. Therefore, 249 new applicants would be required to apply by using the initial application form. The remainder would use the renewal form, and would not likely incur in additional burden. It is estimated that owners/operators of all 249 vessels would apply for a bluefish permit. The total burden cost associated with public requirements is $1,878 ($8 per vessel). The total burden cost associated with federal requirements is estimated at $8,217. It is estimated that 249 new logbooks would be submitted by the new licensed commercial vessels and processed by the government per year. The public and government costs associated with this submission and processing are $4,959 ($20 per vessel) and $6,223, respectively.

It is estimated that approximately 2,063 party/charter vessels would qualify for a bluefish party/charter vessel permits coastwide. Since these vessels already have permits for other party/charter fisheries, and the party/charter permit will remain open access, it is not likely that additional burden (public costs or government costs) will be incurred in this sector. Therefore, no burden costs were identified for the party/charter permits. Licensed party/charter vessels permits issued pursuant to this amendment must submit monthly logbooks. It is estimated that all party/charter vessels participating in the bluefish fishery hold one or more permits for fisheries that require logbook submission (e.g., multispecies, summer flounder, black sea bass, scup, snapper grouper complex, etc.). As such, these vessels are only required to submit one report to meet the reporting requirement for these fisheries. Therefore, no additional burden is anticipated by the addition of bluefish to the list.

It is expected that 37 dealers would be new applicants as a result of this management measure. The calculation of public and federal estimate of reporting costs apply to the new respondents only. The total burden cost associated with public requirements is $46 ($1.25 per dealer). The total burden cost associated with federal requirements is estimated at $1,221. Thereafter, the public annual estimate of submitting weekly reports will be $960 ($26 per dealer per year), and the annual estimate of processing weekly reports for NMFS will be $1,602.

All commercial and party/charter operators participating in the commercial and recreational fisheries should have an operator permit issued by NMFS or a state under other management plans. It is not expected that the implementation of this management alternative will affect the public or NMFS burden cost.

The fifth management alternative deals with the implementation of a commercial quota. Under this alternative, the commercial sector allocation would be set up to 10.50 million lbs (4,763 mt) until such time as the recreational component of the landings is projected to reach 83% of the TAL. The 1999 quota may potentially yield an increase in revenues of $363,600 from the 1996 period. However, it is possible that the increase in landings will result in a decrease in exvessel price per pound, thereby mitigating some of the potential gain in revenues. Combined with the minimum size regulation, the commercial quota will prevent overfishing and reduce waste. As the stock rebuilds and exploitation rates remain constant, commercial quotas would increase. As the stock rebuilds in the long-term, commercial fishermen revenues will also increase. Increases in net benefits in the long-term are expected from the reduction in biological and economic waste that will accrue from the prevention of overfishing.

Alternative 6 (minimum fish size) is presented by the Council as a framework provision. There are no direct economic impacts associated with this alternative. This alternative would allow for modifications in minimum fish size requirements based on updated stock assessments as well as other information such as changes in fishing practices and activities. This added flexibility would allow for rapid management responses which in turn should benefit user groups at some future period. Potential social and economic gains may be derived from the conservation efforts that will ultimately result in a reduction in the mortality of small bluefish, allowing for an increase in yield or harvest as small fish that were previously killed grow larger and add weight to the stock.

Alternative 7 (minimum mesh size regulation) is presented by the Council as a framework provision. There are no direct economic impacts associated with this alternative. This alternative would allow for modifications in minimum mesh requirements based on updated stock assessments as well as other information such as changes in fishing practices and activities. This added flexibility would allow for rapid management responses which in turn should benefit user groups at some future period. The overall net benefit of this management alternative is expected to be positive.

Alternative 8 deals with the implementation of *de minimus* status. Any state that has commercial landings less than 0.1% of the total coastwide commercial landings in the last preceding year for which data are available is eligible for *de minimus*. As such, any state granted *de minimus* status would receive 0.1% of the coastwide bluefish quota. Employing the assumptions discussed in section 3.1.4.1.8, Georgia would receive an additional 9,510 lbs, and South Carolina would receive an additional 6,807 lbs, accounting for an increase in $2,853 and $2,042 in gross revenue from bluefish in the first year, respectively. The effects on the other states would be minimal (i.e., the differences are spread amongst the other 12 states), and their combined gross revenue reduction in the first year would be $4,895.

The ninth alternative deals with the implementation of a recreational harvest limit. Under this alternative, the commercial sector allocation would be set up to 10.50 million lbs (4,763 mt) until such time as the recreational component of the landings is projected to reach 83% of the TAL. Adjusted recreational harvest limit for 1999 would be 24.52 million lbs. This would allow for an increase in recreational landings of 9.78 million lbs (66%) relative to 1996. This may result in an increase in angler satisfaction and benefits in the short-term.

Alternative 10 (size limit in the recreational fishery) is presented by the Council as a framework provision. There are no direct economic impacts associated with this alternative. This alternative would allow for modifications in minimum fish size requirements based on updated stock assessments as well as other information such as changes in fishing practices and activities. This added flexibility would allow for rapid management responses which in turn should benefit user groups at some future period. The overall net benefit of this management alternative is expected to be positive. It is likely that a size limit would result in some decrease in recreational satisfaction. However, there is no indication that this would lead to a decline in the demand for party/charter boat trips coastwide. While the number of bluefish catches has declined over the last decade, the number of fishing trips taken by recreational anglers has substantially increased, and the number of participants in the marine recreational fisheries of the Atlantic coast has been relatively unchanged for the same period.

Alternative 11 deals with the framework provision of the recreational limits. This alternative would add flexibility to the management process by allowing the prompt implementation of measures in the event that the stock declines or stock collapse becomes imminent. Adverse impacts would have to be measured against the prevailing rate of fishing success and would not be as great as when bluefish are abundant or angler effort are less. The overall impact of the implementation of the framework provision would depend on the combination of measures being implemented (e.g., possession limit, size limit, area, and/or season closures) and the geographic area of implementation (e.g., coastwide, single state, etc.). The extent of the impact on the recreational fishery would depend on the number of recreational fishermen targeting bluefish. Party/charter boats are the entities that are most likely to experience negative economic impact due to the implementation of this alternative. Possible decreases in revenue and recreational satisfaction in the short-term would be outweighed by increases in recreational satisfaction and net benefits in the long-term.

4.4.2 Summary of Impacts of the Alternatives to the Amendment

Alternative 1 (Take no action) will not allow for the problems identified in section 1.1.3 of this amendment to be solved. The implementation of this alternative will not reduce overfishing or rebuild the stock, and as a result, economic benefits will not accrue in the long-term.

The second alternative deals with the allocating the annual quota between the recreational and commercial fisheries based on landings for the period 1981 to 1989. Under this alternative, the recreational sector would receive 83% of the annual quota and the commercial sector would receive 17% of the annual quota specified for the upcoming year. This alternative is identical to the preferred alternative described and discussed in sections 3.1.4.1.5 and 3.1.4.1.9, respectively. However, under this non-preferred alternative, there would be no transfer to the commercial fishery if the recreational component of the landings does not reach 83% of the TAL. When compared to the scenario that allows the commercial fishery to increase landings by up to 10.50 million lbs (section 3.1.4.1.5), this non-preferred alternative would result in a loss of revenues of $1.4 million to the commercial fishery in 1999. When compared to the scenario that allows the commercial fishery to increase landings by up to 10.50 million lbs (4,763 mt) (section 3.1.4.1.9), this non-preferred alternative would provide greater recreational landings for 1999 of 29.07 million lbs. This may result in an increase in angler satisfaction and benefits in the short-term.

Alternative 3 deals with the allocating the annual quota between the recreational and commercial fisheries based on landings for the period 1981 to 1993. Under this alternative, the recreational sector would receive 80.9% of the annual quota, and the commercial sector would receive 19.1% of the annual quota specified for the upcoming year. When compared to the to the scenarios that allows the commercial fishery to increase landings by up to 10.50 million lbs (3.1.4.1.5 and 3.1.4.1.9), this non-preferred alternative would result in a loss of revenues of $141,000 in the first year. As with the preferred alternative, the recreational fishery would be allowed to increase landings relative to 1996. Potential increase in angler satisfaction may occur in the long-term. With the implementation of this alternative, the commercial quota and the recreational harvest limit would be specified employing more recent landings data which may reflect current fishing practices. The allocation based on these years may not be as fair and equitable as the preferred alternative because the allocation would be based on a time frame during which regulations for the bluefish fishery were in effect.

Alternative 4 deals with the allocating the annual quota between the recreational and commercial fisheries based on landings for the period 1985 to 1989. Under this alternative, the recreational sector would receive 81.8% of the annual quota, and the commercial sector would receive 18.2% of the annual quota specified for the upcoming year. When compared to the to the scenario that allows the commercial fishery to increase landings by up to 10.50 million lbs (3.1.4.1.5 and 3.1.4.1.9), this non-preferred alternative would result in a loss of revenues of $57,000 in the first year. As with the preferred alternative, the recreational fishery would be allowed to increase landings relative to 1996. Potential increase in angler satisfaction may occur in the long-term. With the implementation of this alternative, the commercial quota and the recreational harvest limit would be specified employing more recent landings data which may reflect current fishing practices. This allocation would be based on a more limited number of years and would not reflect the amount of annual variability in the catch by area and season that is captured in the preferred alternative. This, in turn, could lead to an unfair allocation relative to the preferred alternative.

The fifth alternative deals with the implementation of a state-by-state commercial quota system with allocations based on landings from 1981-1993. The state-by-state allocation based on this time period (1981-1993) may not be as fair and equitable as the preferred alternative because the allocation would be based on a time frame during which regulations for the bluefish fishery were in effect. However, these regulations were not fully implemented by all the states, which renders any allocation based on those years unfair and not equitable. If this alternative was implemented, commercial bluefish shares would decrease in eight states (Maine, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida) when compared to the preferred alternative, ranging from slightly over 0.002% in Georgia to 1.8% in Virginia. At the same time, commercial bluefish shares would increase in six states (New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, and New Jersey) when compared to the preferred alternative, ranging from 0.08% in Massachusetts to 1.2% in Rhode Island.

Alternative 6 requires the implementation of a state-by-state commercial quota system with allocations based on landings from 1985-1989. The state-by-state allocation based on this time frame (1985-1989) is not as appropriate as the preferred alternative since it would be based on a more limited number of years. The shorter time frame upon which the allocation is based would not reflect the amount of annual variability in the catch by area and season that is captured in the preferred alternative. This, in turn, could lead to an unfair allocation relative to the preferred alternative. If this alternative was implemented, commercial bluefish shares would decrease in six states (Maine, Connecticut, New York, Delaware, Virginia, North Carolina, South Carolina, and Florida) when compared to the preferred alternative, ranging from 0.007% in South Carolina to 3.1% in North Carolina. At the same time, commercial bluefish shares would increase in six states (New Hampshire, Massachusetts, Rhode Island, New Jersey, Maryland, and Georgia) when compared to the preferred alternative, ranging from slightly over 0.003% in Georgia to 2.3% in New Jersey.

Alternative 7 requires the implementation of a coastwide trip limit system. This alternative would be relatively easy to enforce because all individuals would be subject to the same trip limit regardless of state of origin or location of fishing. However, an uniform trip limit system will not likely ensure equitable distribution for all areas, gears, and seasons. Therefore, positive long-term benefits may not be achieved.

Alternative 8 deals with the implementation of a maximum fish size limit in the commercial fishery. The effects of this alternative on commercial fishermen would vary between regions and gear employed. Commercial catch would be reduced under this management alternative. The economic impact on commercial fishermen would depend on their ability to substitute the potential income loss by landing another species without additional effort.

Alternative 10 deals with the allocation of quarterly quotas. This type of allocation system could allow for an equitable allocation of the commercial quota to northern and southern participants as well as between the smaller day boats and larger offshore boats.

Alternative 11 deals with four separate bluefish stock rebuilding schedules. Three of the four rebuilding alternatives would achieve biomass target (B_{MSY}) in a shorter period than the preferred stock rebuilding alternative (section 3.1.4.1.1). One of the rebuilding alternatives would achieve biomass target (B_{MSY}) in the same period as the preferred stock rebuilding alternative (section 3.1.4.1.1). However, the preferred rebuilding strategy provides more stable projected yields during the recovery period. All four alternative rebuilding strategies would yield greater economic loses than the preferred schedule due to reductions in commercial landings in 1999 when compared to the 1996 period. All four stock rebuilding alternatives would result in an increase in recreational landings for 1999 relative to 1996.

4.5 DETERMINATION OF SIGNIFICANT REGULATORY ACTION

The proposed action does not constitute a significant regulatory action under Executive Order 12866 for the following reasons. (1) It will not have an annual effect on the economy of more than $100 million. Based on unpublished NMFS preliminary data (Maine-Florida), the total commercial value for bluefish was estimated at $2.8 million in 1996 (Weighout unpublished data). The total bluefish recreational fishery expenditures were estimated at $391-574 million in 1985 (section 2.3.2.2). Since that period, bluefish landings have generally declined, reflecting a drop in availability, abundance and/or anglers interest. As such, it is likely that total bluefish recreational fishery expenditures have decreased in recent years. The measures considered in this amendment are not expected to affect total revenues generated by the commercial and recreational sector to the extent that a $100 million annual economic impact will occur. The proposed actions are necessary to enhance bluefish stock rebuilding and allow for management practices that account for variations in the fishery among others. The proposed action benefits in a material way the economy, productivity, competition, and jobs. The proposed action will not adversely affect, in the long-term, competition, jobs, the environment, public health or safety, or sate, local, or tribal government communities. (2) The proposed actions will not create a serious inconsistency or otherwise interfere with an action taken or planned by another agency. No other agency has indicated that it plans an action that will affect the bluefish fishery in the EEZ. (3) The proposed actions will not materially alter the budgetary impact of entitlements, grants, user fees, or loan programs, or the rights and obligations of their participants. (4) The proposed actions do not raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

4.6 REVIEW OF IMPACTS RELATIVE TO THE REGULATORY FLEXIBILITY ANALYSIS

4.6.1 Introduction

The purpose of the Regulatory Flexibility Act (RFA) is to minimize the adverse impacts from burdensome regulations and recordkeeping requirements on small businesses, small organizations, and small government entities. The category of small entities likely to be affected by the proposed plan is that of commercial and recreational entities harvesting bluefish. The impacts of the proposed action on the fishing industry as a whole were discussed above. The following discussion of impacts centers specifically on the effects of the proposed actions on the mentioned small business entities.

4.6.2 Determination of Significant Economic Impact on a Substantial Number of Small Entities

The Small Business Administration (SBA) defines a small business in the commercial fishing and recreational fishing activity as a firm with receipts (gross revenues) of up to $3.0 million. It is estimated that 2,487 commercial vessels landed bluefish in 1996 along the Atlantic coast. In addition to this, it is estimated that approximately 2,063 party/charter vessels may have been active and/or caught bluefish in recent years. All these vessels readily fall within the definition of small business.

According to the guidelines on regulatory analysis of fishery management actions, a "substantial number" of small entities is more than 20% of those small entities engaged in the fishery. Since the proposed action will directly and indirectly affect most of these vessels, the "substantial number" criterion will be met.

Economic impacts on small business entities are considered to be "significant" if the proposed action would result in any of the following: a) a reduction in annual gross revenues by more than 5%; b) an increase in total costs of production by more than 5% as a result of an increase in compliance costs; c) an increase in compliance costs as a percent of sales for small entities at least 10 % higher than compliance costs as a percent of sales for large entities; d) capital costs of compliance represent a significant portion of capital available to small entities, considering internal cash flow and external financing capabilities; or, e) as a "rule of thumb," 2% of small businesses entities being forced to cease business operations.

4.6.3 Analysis of Economic Impacts

<u>(a) Does this action result in revenue loss of >5% for >20% or more of the participants:</u> The economic effects of the proposed actions on commercial and recreational entities are discussed to the extent possible under the economic impacts section (section 3.1.4). The implementation of the commercial quota may potentially yield an increase in annual gross revenues of $363,600 in the

first year. Assuming that this is the initial decrease in annual revenues for all participants in the fishery, and that it is evenly distributed over all participants in the fishery (2,487 vessels that landed bluefish in 1996), each business unit would gain on average $146. This increase in revenues will not result in a increase in annual gross revenue of more than 5% of the 1996 estimated value of the fishery for the affected business entities. The implementation of the preferred recovery strategy would reduce exvesel gross revenues by $987,000 relative to 1996 ($397 per vessel) if the recreational fishery is allocated the full 83% of the TAL. However, if the commercial sector is allow to maintain its landings up to 10.5 million lbs, results will then be identical as those discussed above under the commercial quota alternative. The implementation of the *de minimus* specifications will only affect revenues slightly, and no major economic changes are expected from it.

The recreational entities that are most likely to experience any change in annual gross revenue as a result of the proposed actions are party/charter boats. Changes in annual gross revenues for these entities will occur if the proposed management measures cause a decrease in recreational satisfaction to the extent that demand for party/charter boat trips declines. While it is possible that the proposed regulations would cause some decrease in recreational satisfaction, there is no indication that it would cause a decline in the overall demand for party/charter boat trips. However, some of the party/charter boats that operate in the Mid-Atlantic region have historically targeted bluefish and may be affected in the short-term by the implementation of these measures. Thus, it is possible that some party/charter boats that are dependent on bluefish trips, and potentially some marginal operations, may experience short-term loss of revenues of more than 5%. However, if this occurs it is not expected that a substantial number of entities will be affected in the short-term. Therefore this threshold is not met.

(b) Does the action result in an increase in compliance costs (annualized capital, operating, reporting, etc.) of >5% for 20% or more of the participants: Compliance costs for participants were described in section 3.1.4. The expected burden costs associated with public and government requirements for the dealer permit during the first year are $1 per dealer and $1,221 for NMFS. Thereafter, the yearly cost associated with submitting weekly dealer reports are $26 per dealer and $1,602 for NMFS. The expected burden costs for the commercial permits for bluefish are $8 per vessel and $8,217 for NMFS. Cost associated with vessel identification was estimated at $21 per vessel (for new vessels applying for new commercial permits). The estimated burden costs associated with public requirements for commercial logbook submission is $20 per vessel per year, and the total associated government cost is $6,223. It is not expected that these burden costs will substantially increase compliance costs for the affected entities. Thus, this threshold is not met.

(c) Does this action result in 2% of the entities ceasing operations: While it is likely that annual gross revenues for the party/charter boat sector is likely to be affected by the proposed management measures, it is not expected that the changes in revenues will trigger this threshold.

The preceding analysis of impacts relative to the regulatory Flexibility Act indicates that, while a substantial number of small entities may be impacted by this action, the proposed management actions in this amendment will not result in significant economic impacts upon a substantial number of such entities. These measures are proposed in order to conserve the bluefish resource along the Atlantic coast. The negative economic impacts upon small entities in the immediate future will be offset by future increases in harvest and associated revenues anticipated from eliminating overfishing.

5.0 OTHER APPLICABLE LAWS

5.1 RELATION OF RECOMMENDED MEASURES TO EXISTING APPLICABLE LAWS AND POLICIES

5.1.1 FMPs

This FMP is related to other plans to the extent that all fisheries of the northwest Atlantic are part of the same general geophysical, biological, social, and economic setting. U.S. fishermen usually are active in more than a single fishery. Thus, regulations implemented to govern harvesting of one species or a group of related species may impact on other fisheries by causing transfers of fishing effort.

5.1.2 Treaties or International Agreements

No treaties or international agreements, other than GIFAs entered into pursuant to the MSFCMA, relate to this fishery.

5.1.3 Federal Law and Policies

5.1.3.1 Marine mammals and endangered species

Numerous species of marine mammals and sea turtles occur in the northwest Atlantic Ocean. The most recent comprehensive survey in this region was done from 1979-1982 by the Cetacean and Turtle Assessment Program (CETAP) at the University of Rhode Island (University of Rhode Island 1982) under contract to the Minerals Management Service (MMS), Department of the Interior. The following is a summary of the information gathered in that study, which covered the area from Cape Sable, Nova Scotia, to Cape Hatteras, North Carolina, from the coastline to 5 nautical miles seaward of the 1,000 fathom isobath.

Four hundred and seventy one large whale sightings, 1,547 small whale sightings, and 1,172 sea turtles were encountered in the surveys. The "estimated minimum population number" for each mammal and turtle in the area, as well as those species currently included under the Endangered Species Act, were also tabulated (University of Rhode Island 1982).

CETAP concluded that both large and small cetaceans were widely distributed throughout the study area in all four seasons and grouped the 13 most commonly seen species into three categories, based on geographical distribution. The first group contained only the harbor porpoise, which is distributed only over the shelf and throughout the Gulf of Maine, Cape Cod, and Georges Bank, but probably not southwest of Nantucket. The second group contained the most frequently encountered baleen whales (fin, humpback, minke, and right whales) and the white-sided dolphin. These were found in the same areas as the harbor porpoise and also occasionally over the shelf at least to Cape Hatteras or out to the shelf edge. The third group indicated a "strong tendency for association with the shelf edge" and included the grampus, striped, spotted, saddleback, and bottlenose dolphins, and the sperm and pilot whales.

Loggerhead turtles were found throughout the study area, but appeared to migrate north to about Massachusetts in summer and south in winter. Leatherbacks appeared to have had a more northerly distribution. CETAP hypothesized a northward migration of both species in the Gulf Stream with a southward return in continental shelf waters nearer to shore. Both species usually were found over the shoreward half of the slope and in depths less than 200 feet. The northwest Atlantic may be important for sea turtle feeding or migrations, but the nesting areas for these species generally are in the South Atlantic and Gulf of Mexico.

This problem may become acute when climatic conditions result in concentration of turtles and fish in the same area at the same time. These conditions apparently are met when temperatures are cool in October but then remain moderate into mid-December and result in a concentration of turtles between Oregon Inlet and Cape Hatteras, North Carolina. In most years, sea turtles leave Chesapeake Bay and filter through the area a few weeks before the bluefish fishery becomes concentrated. Efforts are currently under way (by VIMS and the U.S. Fish and Wildlife Service refuges at Back Bay, Virginia, and Pea Island, North Carolina) to more closely monitor these mortalities due to trawls. Fishermen are encouraged to carefully release turtles captured incidentally and to attempt resuscitation of unconscious turtles as recommended in the 1981 *Federal Register* (pages 43976 and 43977).

The only other endangered species occurring in the northwest Atlantic is the shortnose sturgeon (*Acipenser brevirostrum*). The Councils urge fishermen to report any incidental catches of this species to the Regional Administrator, NMFS, One Blackburn Drive, Gloucester, Massachusetts 01930, who will forward the information to persons responsible for the active sturgeon data base.

The range of bluefish and the above mentioned marine mammals and endangered species overlap, and there always exists a potential for an incidental kill. Except in unique situations, such accidental catches should have a negligible impact on marine mammal or abundances of endangered species, and the Councils do not believe that implementation of this FMP will have any adverse impact upon these populations.

Commercial and recreational fisheries lose thousands of pounds of fishing gear annually. Incidences of entanglement in and ingestion of this gear is common among sea turtles and marine mammals and may result directly or indirectly in some deaths.

5.1.3.2 Marine sanctuaries

National marine sanctuaries are allowed to be established under the National Marine Sanctuaries Act of 1973. Currently, there are 12 designated marine sanctuaries that create a system that protects over 14,000 square miles (National Marine Sanctuary Program 1993).

There are four designated national marine sanctuaries in the area covered by the FMP: the *Monitor* National Marine Sanctuary off North Carolina, the Stellwagen Bank National Marine Sanctuary off Massachusetts, Gray's Reef off Georgia and the Florida Keys National Marine Sanctuary. There is currently one additional proposed sanctuary on the east coast, the Norfolk Canyon.

The *Monitor* National Marine Sanctuary was designated on 30 January 1975, under Title III of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA). Implementing regulations (15 CFR 924) prohibit deploying any equipment in the Sanctuary, fishing activities which involve "anchoring in any manner, stopping, remaining, or drifting without power at any time" (924.3 (a)), and "trawling" (924.3 (h)). The Sanctuary is clearly designated on all National Ocean Service (NOS) charts by the caption "protected area." This minimizes the potential for damage to the Sanctuary by fishing operations. Correspondence for this sanctuary should be addressed to: *Monitor* NMFS, NOAA, Building 1519, Fort Ousts, Virginia 23604.

Gray's Reef was designated a National Marine Sanctuary in January 1981. Located 17 miles off the coast of Georgia, Gray's Reef is one of the largest nearshore sandstone reefs in the southeastern United States. The sanctuary encompasses 17 nm^2 of live-bottom habitat.

Implementing regulations (15 CFR 922.90) permit recreational fishing and commercial fishing is restricted. Specifically, wire fish traps and bottom tending fishing gears (dredges, trawls etc.) are prohibited. Correspondence for this sanctuary should be addressed to: Gray's Reef Sanctuary Manager, 10 Ocean Science Circle, Savannah, Georgia 31411.

NOAA/NOS issued a proposed rule on 8 February 1991 (56 FR 5282) proposing designation under MPRSA of the Stellwagen Bank National Marine Sanctuary, in federal waters between Cape Cod and Cape May, Massachusetts. On 4 November 1992, the Sanctuary was Congressionally designated. Implementing regulations (15 CFR 940) became effective March 1994. Commercial fishing is not specifically regulated by Stellwagen Bank regulations. The regulations do, however, call for consultation between federal agencies and the Secretary of Commerce on proposed agency actions in the vicinity of the Sanctuary that "may affect" sanctuary resources. The process for consultation is currently (late 1995) being worked out between the Regional office of NMFS, the Sanctuary, and NEFMC for Amendment 7 to groundfish. Correspondence for this sanctuary should be addressed to: Stellwagen Bank NMS, 14 Union Street, Plymouth, Massachusetts 02360.

The United States Congress passed the Florida Keys National Marine Sanctuary and Protection Act of 1990 designating the Florida Keys a National Marine Sanctuary. The act required NOAA to develop a comprehensive management plan with implementing regulations to govern the overall management of the Sanctuary and to protect and conserve it's resources. The Sanctuary consists of 2,800 nm^2 of coastal and oceanic waters and the associated submerged lands surrounding the Florida Keys, extending westward to include the Dry Tortugas, but excluding the Dry Tortugas National Park. The sanctuary prohibits the taking of coral or live rock, except as permitted by the NMFS or the state of Florida. The sanctuary contains designated Sanctuary Preservation Areas and Replenishment Reserves where the taking or disturbance of sanctuary resources is prohibited. Fishing is prohibited in these non-consumptive areas. Correspondence for this sanctuary should be addressed to Superintendent, NOAA/Florida Keys National Marine Sanctuary, P.O. Box 500368, Marathon, Florida 33050.

Details on sanctuary regulations may be obtained from the Chief, Sanctuaries and Reserves Division (SSMC4) Office of Ocean and Coastal Resource Management, NOAA, 1305 East-West Highway, Silver Spring, Maryland 20910.

5.1.3.3 Indian treaty fishing rights

No Indian treaty fishing rights are known to exist in the fishery.

5.1.3.4 Oil, gas, mineral, and deep water port development

While Outer Continental Shelf (OCS) development plans may involve areas overlapping those contemplated for offshore fishery management, no major conflicts have been identified to date. The Councils, through involvement in the Intergovernmental Planning Program of the MMS, monitor OCS activities and have opportunity to comment and to advise MMS of the Councils' activities. Certainly, the potential for conflict exists if communication between interests is not maintained or appreciation of each other's efforts is lacking. Potential conflicts include, from a fishery management position: (1) exclusion areas, (2) adverse impacts to sensitive biologically important areas, (3) oil contamination, (4) substrate hazards to conventional fishing gear, and (5) competition for crews and harbor space. The Councils are unaware of pending deep water port plans which would directly impact offshore fishery management goals in the areas under consideration and are unaware of potential effects of offshore FMPs upon future development of deep water port facilities.

5.1.3.5 Paper work reduction act of 1995

The Paperwork Reduction Act concerns the collection of information. The intent of the Act is to minimize the federal paperwork burden for individuals, small business, state and local governments, and other persons as well as to maximize the usefulness of information collected by the federal government.

The Council proposes, through this amendment, to establish the implementation of a party/charter, dealer, and operator permits. The total public reporting burdens for the time for reviewing instructions, searching existing data, collection of information and maintaining the data needed, reviewing the collection of information, and reporting requirements are estimated to be about 628 hours.

5.1.3.6 Impacts of the plan relative to federalism

The amendment does not contain policies with federalism implications sufficient to warrant preparation of a federalism assessment under Executive Order 12612.

5.1.4 State, Local, and Other Applicable Law and Policies

5.1.4.1 State management activities

This plan will apply to all states from Florida to Maine. This includes Florida, Georgia, South Carolina, North Carolina, Virginia, Maryland, Potomac River Fisheries Commission, Delaware, New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, and Maine.

The Commission has established compliance criteria as a part of the interstate management process. The Commission requires that states adopt the following measures in regard to bluefish:

- Commercial size limits and mesh requirements
- Commercial quota provisions
- Commercial fishery closure ability
- Recreational size, possession, and seasonal limits
- Recreational harvest limit
- Permit and reporting requirements

Compliance with Commission management plans is reviewed annually by the Management Board and Plan Review Team through a process outlined in the Interstate Fisheries Management Program (ISFMP) Charter. Each year, the Plan Review Team prepares an FMP status report that documents landings and compliance for each state. If a state is out of compliance with a required management measure, the Team forwards a recommendation of non-compliance to the Management Board. The Board then reviews the recommendations of the Plan Review Team and, if it determines a state is out of compliance, forwards a recommendation of non-compliance to the ISFMP Policy Board. The Policy Board considers the recommendation and makes a final compliance determination.

Amendment 1 also allows states to request *de minimus* status and outlines a procedure for review and determination of *de minimus*.

States often voluntarily adopt management measures that are more restrictive than the federal management program. For example, a number of states have gear restrictions, seasons for specific gear types. State regulations for bluefish are summarized in Table 69.

All the Atlantic coast states have a 10 fish recreational possession limit except Georgia, which has a 15 fish recreational possession limit in conjunction with a 12" FL minimum size limit. Maryland has a 8" TL minimum size limit, while North Carolina and Florida have a 12" FL minimum size limit (these apply to the recreational fisheries only in both states). New York (9" TL) and Maryland (8" TL) are the only states with commercial minimum size limits. All the states require a commercial license to sell bluefish. New Hampshire has a July-September season. Massachusetts imposes a 5,000 lb trip limit and gill net restrictions. Connecticut prohibits pair trawls, purse seines, and roller rig gill nets and has a season which opens on April 15. New York prohibits pair trawls and imposes a January-October 15 season, excluding otter trawls. For otter trawls in New York, the season is July 1-November 15. During the closed seasons, there is a 100 lb bycatch limit in effect. New Jersey imposes seasons as follows; gill nets January 1- November 6, otter trawls January 1- December 7, hook and line June 16-August 7, pound nets January 1- December 31. Purse seines have no season, but will close once their share is landed. Delaware prohibits the use of trawls and purse seines, has a limited entry program in effect, and restricts the amount of gill net which may be fished. Maryland requires monthly reporting of landings.

5.1.4.1.1 Compliance reporting contents and schedules

Each state must submit an annual report concerning it bluefish fisheries and management program on or before May 1 of each year, beginning May 1, 1999. The report shall cover:

> A) the previous year's fishery and management program including activity and results of monitoring, regulations which were in effect and harvest information that is available, including estimates of non-harvest losses if available, and
>
> B) the planned management program for the current calendar year summarizing regulations that will be in effect and monitoring programs that will be performed, highlighting and changes from the previous year.

5.1.4.1.2 Procedures for determining compliance

Procedures for determining a state's compliance with the provisions of a fisheries management plan are contained in Section 7 of the Interstate Fisheries Management Program Charter (ASMFC 1998). The following compliance determination will be done in addition to the bluefish FMP monitoring committee activity detailed in section 3.1.1.6. The following represents compliance determination procedures as applied to this plan:

The Plan Review Team (PRT) will continually review the status of state implementation and advise the Management Board at any time that a question arises concerning state compliance. The PRT will review state reports submitted under section 5.1.4.1.1 and prepare a report by July 1 for the Management Board summarizing the status of the resource and the fishery and the status of compliance on a state-by-state basis.

Upon review of a report from the PRT, or at any time by request from a member of the Management Board, the Management Board will review the status of an individual state's compliance. If the Management Board finds that a state's approved regulatory and management program fails to meet the requirements of this section, it may recommend that the state be found out of compliance. The recommendation must include a specific list of the state's deficiencies inn implementing and enforcing the FMP and the actions that the state must take in order to come back in compliance.

If the Management Board recommends that a state be found out of compliance as referred to in the preceding paragraph, it shall report that recommendation to the ISFMP Policy Board for further review according to the Commission's Charter for the Interstate Fisheries Management Program.

The state that is out of compliance or subject to a recommendation by the Management Board under the preceding subsection may request at any time that the Management Board reevaluate its program. The state shall provide a written statement concerning its actions which justify a reevaluation. The Management Board shall promptly conduct such reevaluation and, if it agrees with the state, shall recommend to the ISFMP Policy Board that the determination on noncompliance be withdrawn. The ISFMP Policy Board and the Commission shall deal with the Management Board's recommendation according to the Commissions Charter for the Interstate Fisheries Management Program.

5.1.4.1.3 Alternatives to recreational limits

In order to achieve annual fishing mortality targets, recreational fisheries will be constrained by a regime of size limits, bag limits, and seasons. Once a basic regime for these limits is established, states will be given the opportunity to vary these measures according to specified table of equivalency developed by the ASMFC Bluefish Technical Committee. A state may modify their limits based on the following procedures:

A) A state may submit a proposal for a change to its regulatory program or any mandatory compliance measure under this amendment to the Commission. Such changes shall be submitted to the ASMFC staff, which will distribute the proposal to the Management Board, the Plan Review Team, the Technical Committee, the Stock Assessment Subcommittee, and the Advisory Panel.

B) States must submit proposals at least two weeks prior to a planned meeting of the Technical Committee.

C) The Plan Review Team is responsible for gathering the comments of the Technical Committee, the Stock Assessment Subcommittee, and the Advisory Panel and presenting these comments to the Management Board for decision.

D) The Management Board will decide whether to approve the state proposal for an alternative management program if it determines that it is consistent with the target fishing mortality rate and the goals and objectives of this amendment.

5.1.4.1.4 Adaptive management process

The Commission will participate in the framework process to adjust management measures. The Commission's Bluefish Management Board will attend all Council framework meetings. During the framework process, the Management Board will solicit public participation by submitting all proposed changes to each interested state for public comment.

In accordance with the Commission's Interstate Fisheries Management Program Charter, each fishery management plan may provide for changes within the management program to adapt to changing circumstances. Changes made under adaptive management shall be documented in writing through addenda to the fishery management plan. The Management Board shall in coordination with each relevant state, utilizing that state's established public review process, ensure that the public has an opportunity to review and comment upon proposed adaptive management changes. The states shall adopt adaptive management changes through established legislative and regulatory procedures. However, the states may have a large range of procedures and time frames involved with adjusting and implementing fishery regulations.

5.1.4.2 Impact of federal regulations on state management activities

The management measures of this FMP complement or are identical to those proposed by Commission for the coastal states.

5.1.4.3 Coastal zone management program consistency

The CZM Act of 1972, as amended, provides measures for ensuring stability of productive fishery habitat while striving to balance development pressures with social, economic, cultural, and other impacts on the coastal zone. It is recognized that responsible management of both coastal zones and fish stocks must involve mutually supportive goals.

The Council must determine whether the FMP will affect a state's coastal zone. If it will, the FMP must be evaluated relative to the state's approved CZM program to determine whether it is consistent to the maximum extent practicable. The states have 45 days in which to agree or disagree with the Councils' evaluation. If a state fails to respond within 45 days, the state's agreement may be presumed. If a state disagrees, the issue may be resolved through negotiation or, if that fails, by the Secretary.

The FMP was reviewed relative to CZM programs of Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia, and Florida. Letters will be sent to all of the states listed along with a hearing draft of the FMP. The letters to all of the states will state that the Council concluded that the FMP would not affect the state's coastal zone and was consistent to the maximum extent practicable with the state's CZM program as understood by the Council.

6.0 COUNCIL REVIEW AND MONITORING OF THE FMP

The Councils and Commission will monitor the fishery using the best available data, including that specified in section 3.1.1.11. The commercial, recreational, biological, and survey data specified in section 3.1.1.11 are critical to the evaluation of the management measures adjustment mechanism. It is necessary that NMFS incorporate all of the above data types from all Atlantic coast bluefish fisheries into the overall NEFSC data bases. Additionally, improved stock assessments are necessary for FMP monitoring. As a result of that monitoring, the Councils and Commission will determine whether it is necessary to amend the FMP.

The primary organization in the review and monitoring process will be the Bluefish FMP Monitoring Committee (section 3.1.1.6).

7.0 LIST OF PREPARERS

This amendment was prepared by the following members of the MAFMC staff - Dr. Christopher M. Moore, Richard J. Seagraves, José L. Montañez, Dr. Thomas B. Hoff, and Valerie M. Whalon. Dr. Jeffrey Cross of NMFS Sandy Hook and Timothy Goodger of NMFS Oxford, contributed greatly to the EFH information.

8.0 AGENCIES AND ORGANIZATIONS

In preparing the amendment, the Council consulted with the NMFS, the New England Fishery Management Council, the South Atlantic Fishery Management Council, the Fish and Wildlife Service, the Department of State, and the States of New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina through their membership on the Council and the following committees - ASMFC Bluefish Technical Committee, MAFMC Statistical and Science Committee, MAFMC Coastal Migratory Committee, ASMFC Bluefish Board, ASMFC/MAFMC Bluefish Advisory Panel, Mid-Atlantic EFH Technical Committee, Northeast Region Steering Committee, MAFMC Habitat Committee, and MAFMC Habitat Advisory Panel. In addition to the states that are members of this Council, Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, South Carolina, Georgia and Florida were also consulted through the Coastal Zone Management Program consistency process.

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Table 1. Estimated fishing mortality rates (F) and biomass for bluefish from 1974 to 1997. Estimates are from Gibson and Lazar (1998a).

Year	F	Biomass ('000 lbs)
1974	0.53	140,611
1975	0.46	148,702
1976	0.40	164,266
1977	0.36	184,505
1978	0.32	208,116
1979	0.46	216,318
1980	0.52	204,677
1981	0.61	184,725
1982	0.56	169,139
1983	0.70	151,832
1984	0.58	138,825
1985	0.46	143,852
1986	0.84	130,756
1987	0.93	98,458
1988	0.86	76,743
1989	0.78	66,249
1990	0.76	61,046
1991	0.93	52,668
1992	0.86	43,629
1993	0.84	38,294
1994	0.74	36,024
1995	0.63	37,677
1996	0.59	42,285
1997	0.51	49,979

Table 2. Mean total lengths (in)[a] of bluefish by age class collected by the states of New Hampshire (NH), Connecticut (CT), North Carolina (NC), New York (NY), and Maryland (MD), as well as coastwide estimates (Atl.). All estimates of mean length were back-calculated values except for the Maryland data, which are mean lengths at capture. N = sample size.

		Age										
	N	1	2	3	4	5	6	7	8	9	10	11
NH[1]	76	10.3	18.3	24.1	27.8	30.5	32.5	33.9	35.1			
CT[2]	1087	11.1	17.8	22.1	26.0	29.4	31.7	33.2	34.4			
NC[3]	1062	11.1	20.1	26.5	28.6	30.7	32.5	33.5	34.7	35.1	36.1	37.0
Atl.[4]	7425	9.3	14.9	19.7	24.5	28.0	29.9	32.0				
NY[5]	64	10.3	17.7	21.8	25.9	28.5	30.7	31.6				
MD[6]	976	15.6	20.1	24.4	25.9	28.5	33.9	34.9	36.5	37.5		

[a] - Total lengths (TL) were calculated from fork lengths (FL) using the equation (Bonzek and Morin 1987):
TL = 1.129 (FL) + 0.005, N = 814, r^2 = 0.99

[1] - 1986, Robert Fawcett pers. comm.
[2] - 1984-1985, Howell-Heller and Simpson (1986)
[3] - 1982-1985, Jeff Ross pers. comm.
[4] - Wilk (1977)
[5] - Richards (1976)
[6] - 1985-1986, Bonzek and Morin (1987)

Table 3. Theoretical growth parameters (with correlation coefficients)of bluefish collected in several studies. Parameters were derived from back-calculated total lengths (in) presented in Table 2.

	L-inf	K	t_o	r^2
New Hampshire 1986	37.30	0.351	0.083	0.999
Connecticut 1984-85	39.25	0.258	-0.293	0.999
No. Carolina 1982-85	36.77	0.373	-0.013	0.996
Atlantic (Wilk 1977)	40.85	0.216	-0.152	0.998
New York (1976)	35.34	0.322	-0.079	0.998

Table 4. Diet items of bluefish listed from several different study areas.

Source	Life History Stage and Study Location	Diet Items, in Order of Importance
Texas Instruments 1976	Young-of-the-year, Hudson River (tidal)	*Anchoa mitchilli* (dominated diet through summer), Clupeidae, *Microgadus tomcod, Alosa sapidissima, Notropis hudsonius*, Cyprinodontidae
Festa 1979	11-20 cm, Little Egg Harbor estuary, NJ	*Fundulus* spp., Atherinidae, *Anchoa* spp., *Callinectes sapidus, Brevoortia tyrannus, Crangon septemspinosa*
Friedland et al. 1988	Juvenile, Sandy Hook, NJ	1981: Teleosts, Crustacea, Polychaeta 1982: Crustacea, Teleostei, Polychaeta 1983: Crustacea, Teleostei, Polychaeta (Weight at length significantly greater in 1981)
Hartman & Brandt 1995	Age 0, Age 1, & Age 2, Chesapeake Bay (Diets of all age classes changed through season)	Age 0: *Anchoa mitchilli, Menidia menidia, Brevoortia tyrannus* Age 1: *Leiostomus xanthurus, A. mitchilli, M. menidia, B. tyrannus* Age 2: *Micropogonias undulatus, A. mitchilli, B. tyrannus* (*B. tyrannus* becomes important in diets of all age classes in Sep-Oct.)
Buckel & Conover 1997	Young-of-the-year, Hudson River Estuary	Unident. fish, *Anchoa mitchilli, Alosa* spp., *Morone saxatilis, Morone americana*
NEFSC, Trawl Survey Diet Data	All ages (mean size 35.6 mm FL), continental shelf, Georges Bank & Middle Atlantic Bight	1973-1980: Unident. Fishes, *Illex* spp., *Etrumeus teres, Loligo* spp., *Peprilus triacanthus*, Cephalopoda 1981-1990: Unident. Fishes, *Ammodytes dubius, Peprilus triacanthus, Loligo* spp., *Clupea harengus*

Source: Fahay 1998.

Table 5. Bluefish habitat parameters. MAB = Middle Atlantic Bight; SAB = South Atlantic Bight.

Eggs

Authors	Study Period and Area	Habitat (Spatial and Temporal)	Temperature (C)	Salinity (ppt)	D.O.	Currents	Light	Prey
Berrien and Sibunka, in press	1977-1987, Continental Shelf waters, Gulf of Maine to Cape Hatteras	Occur Southern New England to Cape Hatteras across entire shelf. Most in mid-shelf waters of MAB, especially off N.J. and Delaware Bay. May-August.	---	---	---	---	---	---
Present Study	1973-1980, SAB; 1977-1987, MAB	SAB: No data; MAB: most found over depths of 20-40 m, May-August, peak in July	SAB: No data; MAB: Most in 18-22C	---	---	---	---	---
Norcross et al. 1974	1960-1962, Continental Shelf waters off Virginia	Across shelf, from nearshore to shelf edge, but most in outer half of shelf. June through August, peak July.	22 or more. (Minimum 18)	31 or more. (Minimum 26.6)	---	Prevailing surface currents transport eggs south and offshore	Peak spawning evening (1900-2100 hrs.)	---

Larvae

Authors	Study Period and Area	Habitat (Spatial and Temporal)	Temperature (C)	Salinity (ppt)	D.O.	Currents	Light/Vertical Distribution	Prey
Norcross et al. 1974	1960-1962, Continental Shelf waters off Virginia	Surface waters, most near edge of shelf.	---	---	---	---	---	---
Kendall and Walford 1979	1965-1967, Continental Shelf waters between Cape Cod and Palm Beach, Fla.	Late April: in and near Gulf Stream off Cape Hatteras; May: near edge of shelf off Carolinas. August: mid-shelf depths off N.J. September: few in New York Bight. October: concentration near shelf edge off Georgia.	C. Hatteras: 22.1-22.4; MAB: 18-26 C. SAB: 20-26	MAB: 30-32. SAB: 35-38	---	Larvae from spring spawn advected north via Gulf Stream	---	---
Kendall and Naplin 1981	July 1974, outer Continental Shelf off Delaware bay	Vertical distribution study. Most larvae within 4m of surface.	Surface 23	Surface 33	---	---	Near surface at night; mostly at 4 m during daylight	Mostly copepod life history stages. Guts full during day; empty during night
Collins and Stender 1987	1973-1980, Cape Hatteras to Cape Canaveral, FL	Mostly in waters >40m, primarily in spring, secondarily in late summer	---	---	---	Southerly counter-current retains larvae in SAB	> 4 mm strongly associate with surface	---
Powles 1981	1973-1976, Cape Fear to Cape Canaveral, FL	Peaked April-May; smallest near edge of shelf; larger closer to shore or advected north	Smallest larvae >24	Smallest larvae >35	---	Ekman drift would impede inshore migration	Predominately neustonic	---
Present Study	SAB: 1973-1980; MAB: 1977-1987	SAB: Most April-May near edge of shelf MAB: May-September, peak July, mostly between depths 30-70 m	SAB: No data MAB: Most 18-24C	---	---	SAB: subject to northward advection by Gulf Stream	---	---
Hare and Cowen 1996	March 1990, 1991; April 1989; June 1991; Various water masses off Cape Hatteras	Larvae occurred March through June; different sizes occurred in different water masses	March: 20-25; April: 18-25; June: 21-25	March: 36+; April: 34.5-36.5; June: 31-36	---	SW winds in MAB may facilitate cross-shelf transport of larvae	---	---

Table 5 (continued). Bluefish habitat parameters. MAB = Middle Atlantic Bight; SAB = South Atlantic Bight.

Pelagic-Juveniles

Authors	Study Period and Area	Habitat (Spatial and Temporal)	Temperature (C)	Salinity (ppt)	D.O.	Currents	Light/Vertical Distribution	Prey
Hare and Cowen 1996	1988, MAB shelf edge	Cross shelf from Slope Sea to shore early- to mid-June	13.0-15.0	---	---	Wind-driven flow may be important, but active swimming probably more important	Surface oriented	---
Kendall and Walford 1979	1965-1972, East Coast U.S. (MAB and SAB Continental Shelf into Slope Sea)	April (late): many near Cape Hatteras May: shelf in SAB; largest nearshore June: MAB between shore and shelf/slope front Fall: few between Delaware Bay and Cape Hatteras Winter: few between St. Johns River and Cape Canaveral	April-May: 22.1-24.0 Jun: 15.0-20.0 (most >18.0) Fall: 15.0-18.0 Winter: 13.0-15.0	---	---	Migrate across shelf from shelf/slope front to shore as shelf waters warm	All collected in near-surface samplers	---
Collins and Stender 1987	1973-1980, SAB Cape Fear-Cape Canaveral	Seaward of 40 m isobath, mostly spring, some fall occurrences	---	---	---	Strong negative correlation of size and depth during spring, indicates shoreward movement with growth	Strongly associated with the surface	---
Fahay 1975	Seasonal, May 1967-Feb. 1968. SAB Continental Shelf	14 collected between N.C. and Cape Canaveral, various depths between nearshore and shelf edge. All during May.	19.0-24.0	---	---	---	---	---
Powles 1981	1973-1976; SAB Cape fear-Cape Canaveral	Smallest collected near 180 m contour; larger near shore	180 m contour: >24.0	180 m contour: >35.0	---	Weak association of size with proximity to coast. Most probably advected north.	Strongly associated with the surface	---

Table 5 (continued). Bluefish habitat parameters. MAB = Middle Atlantic Bight; SAB = South Atlantic Bight.

Juveniles and Older

Authors	Study Period and Area	Habitat (Spatial and Temporal)	Temperature (C)	Salinity (ppt)	D.O. (ppm)	Currents/Tide	Substrate/Vegetation	Light/Diel	Prey
Nyman and Conover 1988	1985-1986, both shores of Long Island, N.Y.	Occur in embayments, between late May and October	Arrive > 20; emigrate ca. 15	---	---	---	---	---	---
Rountree and Able 1992; 1993	1988-1989, Great South Bay, N.J.	Occur in polyhaline subtidal marsh creeks during summer	> 20.0	23.0-30.0	---	---	---	Day: tidal creeks Night: open bay	Menidia menidia
Able et al. 1996	Great Bay, N.J.	Most bluefish in subtidal creeks	19.0-28.0	25.0-33.0	---	---	0.3-1.2 m depth; Ulva lactuca	---	---
Milstein et al. 1977	1972-1974, Great Bay, N.J.	Several distinct habitats studied; bluefish most abundant in mud-sand, high salinity sites; also sandy beaches	---	---	---	Slow to moderate, swept by waves	Mostly sand, some gravel, silt, clay; Ulva lactuca, Spartina alterniflora, Fucus (sometimes)	---	---
Smith 1971	1969-1970, four low-salinity creeks, upper Delaware bay	Six YOY occurred in two of the creeks, June and July	24.5-30.0	0-5.2	4.5-7.3	Ebb/flood	Sand/gravel.	Day	---
Pristas and Trent 1977	1972, St. Andrews Bay, Fla.	Range of depths sampled with gill nets, 24-hours. Bluefish mose dense in shallowest zone (0.7-1.1 m)	11.4-27.0	25.3-34.6	---	---	>80% sand; vegetation most dense in shallow zone.	Bluefish most abundant at night in shallowest zone	---
McBride et al. 1995	Narragansett Bay, R.I.	June-October, shallow beaches	18.0-28.0	25.0-34.0	---	---	Cobble, gravel, shell, sand; Ulva and some Zostera	Day sampling only	---
deSylva et al. 1962	1958-1960, Delaware Bay and River	July and August, mostly in shore zone of lower estuary	---	usually high, but as low as 3.0	---	Surf zone, clear to turbid	Sand	---	Collected with small clupeids and anchovies
Buckel and Conover 1997	1992-1993, Hudson River estuary	Mid-channel and nearshore day-night occurrence and feeding study	---	---	---	---	---	Most abundant nearshore during daylight; mid-channel at night and twilight	Gut fullness highest twilight and day, usually low at night. Prey: clupeids, striped bass and bay anchovy
Present Study	1964-1997, Continental shelf MAB, south to Cape Fear, Cape Kennedy	Inner shelf (over depths < 20m) during summer and fall	Most 18-22C	---	---	---	---	---	

Source: Fahay 1998.

Table 6. Distribution of early life history stages of bluefish in representative estuaries between Maine and Florida. Occurrences are not quantitative and may be based on a single, or very few, specimens.

Estuary	Eggs	Larvae	Juveniles
Passamaquoddy Bay, ME	None	None	Rare
Englishman/Machias Bay, ME	None	None	Rare
Narraguagus Bay, ME	None	None	Rare
Blue Hill Bay, ME	None	None	Rare
Penobscot Bay, ME	None	None	Common
Muscongus Bay, ME	None	None	Common
Damariscotta River, ME	None	None	Common
Sheepscot River, ME	None	None	Common
Kennebec/Androscoggin Rivers, ME	None	None	Common
Casco Bay, ME	None	None	Common
Saco Bay, ME	None	None	Common
Wells Harbor, ME	None	None	Common
Great Bay, ME/NH	None	None	Common
Merrimack River, NH	None	None	Rare
Massachusetts Bay, MA	None	None	Common
Boston Harbor, MA	None	None	Common
Cape Cod Bay, MA	None	None	Common
Nauset Marsh, MA	None	None	None
Buzzards Bay, MA	None	Rare	Abundant
Narragansett Bay, RI	None	Rare/common	Abundant
Connecticut River, CT	None	None	Abundant
Long Island Sound, NY	None	None	Abundant
Gardiners Bay, NY	Rare	Rare	Abundant
Great South Bay, NY	None	None	Abundant
Hudson River, Raritan/Sandy Hook Bays, NY/NJ	Rare	Rare	Abundant
Barnegat Bay, NJ	None	Rare	Abundant

Source: Fahay 1998.

Table 6 (continued). Distribution of early life history stages of bluefish in representative estuaries between Maine and Florida. Occurrences are not quantitative and may be based on a single, or very few, specimens.

Estuary	Eggs	Larvae	Juveniles
Great Bay, NJ	None	Rare	Common
Southern Inland bays, NJ	None	Rare	Abundant
Delaware Bay, NJ/DL	None	rare	Abundant
Delaware Inland bays, DL	None	None	Common
Eastern Shore, MD/VA	None	Rare	Common
Chesapeake Bay Mainstem, MD/VA	None	None	Abundant
Chester River, MD	None	None	Common
Choptank River, MD	None	None	Common
Patuxent River, MD	None	None	Common
Potomac River, MD/VA	None	None	Abundant
Tangier/Pocomoke Sound, VA	None	None	Abundant
Rappahannock River, VA	None	None	Abundant
York River, VA	None	None	Abundant
James River, VA	None	None	Abundant
Albemarle Sound, NC	None	None	Common
Pamlico Sound, NC	None	None	Abundant
Pungo River, NC	None	None	Common
Neuse River, NC	None	None	Common
Bogue Sound, NC	None	None	Common
New River, NC	None	None	Common
Cape Fear River, NC	None	None	Abundant
Winyah Bay, SC	None	None	Common
Santee Rivers (N&S), SC	None	None	Common
Charleston Harbor, SC	None	None	Common
St. Helena Sound, SC	None	None	Common

Source: Fahay 1998.

Table 6 (continued). Distribution of early life history stages of bluefish in representative estuaries between Maine and Florida. Occurrences are not quantitative and may be based on a single, or very few, specimens.

Estuary	Eggs	Larvae	Juveniles
Broad River, SC	None	None	Common
Savannah River, SC/GA	None	None	Common
Ossabow Sound, GA	None	None	Common
Sapelo Sound/ St. Catherine, GA	None	None	Common
Altamaha River, GA	None	None	Common
St. Andrew/St. Simon Sound, GA	None	None	Common
St. Johns River, FL	None	None	Common
Indian River, FL	None	None	Rare
Biscayne Bay FL	None	None	Rare

Source: Estimates of relative abundance after Nelson and Monaco 1991; Jury *et al.* (1994); Stone *et al.* (1994). Certain Middle Atlantic Bight estuaries after Able and Fahay (in press) in Fahay 1998.

Table 7. Spatial distribution and relative abundance of bluefish in Atlantic coast estuaries.

	North Atlantic Estuaries																	
	Passamaquoddy Bay			Englishman Machias Bays			Narraguagus Bay			Blue Hill Bay			Penobscot Bay			Muscongus Bay		
Life Stage	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
A		▼	▼		▼	▼		▼	▼		▼	▼		●	●		●	●
S																		
J		▼	▼		▼	▼		▼	▼		▼	▼		●	●		●	●
L																		
E																		

	Damariscotia River			Sheepscot River			Kennebec/ Androscoggin Rivers			Casco Bay			Saco Bay			Wells Harbor		
Life Stage	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S	✳	M	S
A		●	●		●	●		●	●		●	●		●	●		●	●
S																		
J		●	●		●	●		●	●		●	●		●	●		●	●
L																		
E																		

	Great Bay			Merrimack River			Massachusetts Bay			Boston Harbor			Cape Cod Bay		
Life Stage	T	M	S	T	M		✳	✳	S	✳	M	S	✳	M	S
A		●	●		▼				●		●	●		●	●
S															
J		●	●		▼				●		●	●		●	●
L															
E															

Relative Abundance

▲ - Highly Abundant
■ - Abundant
● - Common
▼ - Rare
Blank - Not present

Salinity Zone

T - Tidal Fresh
M - Mixing
S - Seawater
✳ - Salinity Zone not present

Life stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Egg

Source: Nelson *et al.* 1991, Jury *et al.* 1994, Stone *et al.* 1994.

Table 7 (continued). Spatial distribution and relative abundance of bluefish in Atlantic Coast estuaries.

	Mid-Atlantic Estuaries																	
	Waquiot Bay			Buzzards Bay			Narragansett Bay			Long Island Sound			Connecticut River			Gardiners Bay		
Life Stage	*	M	S	*	M	S	T	M	S	T	M	S	T	M	*	*	M	S
A		▼	●		●	●		●	●		●	■		●			●	●
S																		▼
J		●	●		■	■	▼	■	■	▼	■	■		■			■	■
L			▼			▼		▼	●									▼
E																		▼

	Great South Bay			Hudson R./ Raritan B.			Barnegat Bay			New Jersey Inland Bays			Delaware Bay			Delaware Inland Bays		
Life Stage	*	M	S	T	M	S	T	M	S	T	M	S	T	M	S	*	M	S
A		●	■		●	●		●	●		●	●		●	●		●	●
S																		
J		■	■	▼	■	■		■	■		■	■	▼	■	■		●	●
L				▼	▼	▼			▼			▼			▼			
E						▼												

	Chincoteague Bay			Chesapeake Bay Mainstem			Chester River			Choptank River			Patuxent River			Potomac River		
Life Stage	*	*	S	T	M	S	T	M	*	T	M	*	T	M	*	T	M	*
A			●		■	■		●			●			●			■	
S																		
J			●		■	■		●			●			●			■	
L																		
E																		

	Tangier/ Pocomoke Sound			Rappahannock River			York River			James River		
Life Stage	*	M	*	T	M	*	T	M	*	T	M	*
A		■			■			■			■	
S												
J		■			■			■			■	
L												
E												

Relative Abundance

▲ - Highly Abundant
■ - Abundant
● - Common
▼ - Rare
Blank - Not present

Salinity Zone

T - Tidal Fresh
M - Mixing
S - Seawater
* - Salinity Zone not present

Life stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Egg

Source: Nelson *et al.* 1991, Jury *et al.* 1994, Stone *et al.* 1994.

Table 7 (continued). Spatial distribution and relative abundance of bluefish in Atlantic Coast estuaries.

Southeast Estuaries

Life Stage	Albemarle Sound			Pamlico Sound			Pamlico/ Pungo Rivers			Neuse River			Bougue Sound			New River			Cape Fear River		
	T	M	✳	T	M	S	T	M	✳	T	M	✳	T	M	S	T	M	S	T	M	S
A		●			■	■		●			▼				■		▼	▼			●
S																					
J	●	●		▼	■	■	▼	●			●			●	■	▼	●	●	▼	■	■
L																					
E																					

Life Stage	Winyah Bay			N & S Santee Rivers			Charleston Harbor			St. Helena Sound			Broad River			Savannah River			Ossabaw Sound		
	T	M	S	T	M	✳	T	M	S	T	M	S	T	M	S	T	M	S	T	M	S
A			▼		▼							●			●						
S																					
J		●	■		●			●	●		●	●		●	●		●	●		●	●
L																					
E																					

Life Stage	St. Cathe/ Sapelo Sound			Altamaha River			St. Andrew /St. Simon Sound			St. Johns River			Indian River			Biscayne Bay		
	T	M	S	T	M	S	T	M	S	T	M	S	✳	M	S	✳	M	S
A												●		▲	▲			
S																		
J		●	●		●	●		●	●		●	●		▼	▼		▼	▼
L																		
E																		

Relative Abundance

▲ - Highly Abundant
■ - Abundant
● - Common
▼ - Rare
Blank - Not present

Salinity Zone

T - Tidal Fresh
M - Mixing
S - Seawater
✳ - Salinity Zone not present

Life stage

A - Adults
S - Spawning adults
J - Juveniles
L - Larvae
E - Eggs

Source: Nelson *et al.* 1991, Jury *et al.* 1994, Stone *et al.* 1994.

Table 8. **Temporal distribution and relative abundance of bluefish in Atlantic Coast estuaries.**

	North Atlantic Estuaries																																			
Estuary / Month	Passamaquoddy Bay												Englishman/Machias Bays												Narraguagus Bay											
Life Stage	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
A						R	R	R	R	R								R	R	R	R	R								R	R	R	R	R		
S																																				
J						R	R	R	R	R								R	R	R	R	R								R	R	R	R	R		
L																																				
E																																				
Estuary / Month	Blue Hill Bay												Penobscot Bay												Muscongus Bay											
Life Stage	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
A						R	R	R	R	R								R	C	C	C	R								R	C	C	C	R		
S																																				
J						R	R	R	R	R								R	C	C	C	R								R	C	C	C	R		
L																																				
E																																				
Estuary / Month	Damariscotia River												Sheepscot River												Kennebec/ Androscoggin Rivers											
Life Stage	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
A						R	C	C	C	R								R	C	C	C	R							R	C	C	C	C	R		
S																																				
J						R	C	C	C	R								R	C	C	C	R							R	C	C	C	C	R		
L																																				
E																																				
Estuary / Month	Casco Bay												Saco bay												Wells Harbor											
Life Stage	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
A						R	C	C	C	R								R	C	C	C	R								R	C	C	C	R		
S																																				
J						R	C	C	C	R								R	C	C	C	R								R	C	C	C	R		
L																																				
E																																				

Relative Abundance

H - Highly Abundant
A - Abundant
C - Common
R - Rare
Blank - Not Present
na - No Data Available

Life Stage

A - Adults
S - Spawning Adults
J - Juveniles
L - Larvae
E - Eggs

Source: Nelson *et al.* 1991, Jury *et al.* 1994, Stone *et al.* 1994.

Table 8 (continued). Temporal distribution and relative abundance of bluefish in Atlantic Coast estuaries.

North Estuaries

Estuary / Month: Great Bay	J	F	M	A	M	J	J	A	S	O	N	D
A					*R*	*R*	*C*	*C*	*C*	*R*		
S												
J					*R*	*R*	*C*	*C*	*C*	*R*		
L												
E												

Estuary / Month: Merrimack River	J	F	M	A	M	J	J	A	S	O	N	D
A					*R*	*R*	*R*	*R*	*R*	*R*		
S												
J					*R*	*R*	*R*	*R*	*R*	*R*		
L												
E												

Estuary / Month: Massachusetts Bay	J	F	M	A	M	J	J	A	S	O	N	D
A					*R*	*C*	*C*	*C*	*C*	*C*		
S												
J					*R*	*C*	*C*	*C*	*C*	*C*		
L												
E												

Estuary / Month: Boston Harbor	J	F	M	A	M	J	J	A	S	O	N	D
A					*R*	*C*	*C*	*C*	*C*	*C*		
S												
J					*R*	*C*	*C*	*C*	*C*	*C*		
L												
E												

Estuary / Month: Cape Cod Bay	J	F	M	A	M	J	J	A	S	O	N	D
A					*R*	*C*	*C*	*C*	*C*	*C*		
S												
J					*R*	*C*	*C*	*C*	*C*	*C*		
L												
E												

Mid-Atlantic Estuaries

Estuary / Month: Waquiot Bay	J	F	M	A	M	J	J	A	S	O	N	D
A					*R*	*R*	*C*	*C*	*C*	*C*	*R*	
S												
J					*R*	*C*	*C*	*C*	*C*	*C*	*C*	
L						*R*	*R*	*R*				
E												

Estuary / Month: Buzzards Bay	J	F	M	A	M	J	J	A	S	O	N	D
A			*R*	*C*	*R*	*C*	*C*	*C*	*C*	*C*	*C*	
S												
J					*R*	*C*	*C*	*A*	*A*	*A*	*C*	
L						*R*	*R*	*R*				
E												

Estuary / Month: Narragansett Bay	J	F	M	A	M	J	J	A	S	O	N	D
A					*C*	*C*	*C*	*C*	*C*	*C*	*C*	
S												
J					*C*	*C*	*C*	*A*	*A*	*A*		
L						*R*	*C*	*R*				
E												

Estuary / Month: Long Island Sound	J	F	M	A	M	J	J	A	S	O	N	D
A				*C*	*C*	*A*	*A*	*A*	*C*	*C*	*C*	*R*
S												
J						*C*	*A*	*A*	*A*	*A*	*R*	*R*
L												
E												

Estuary / Month: Connecticut River	J	F	M	A	M	J	J	A	S	O	N	D
A						*C*	*C*	*C*	*C*	*C*	*R*	
S												
J								*A*	*A*	*A*		
L												
E												

Estuary / Month: Gardiners Bay	J	F	M	A	M	J	J	A	S	O	N	D
A					*C*	*C*	*C*	*C*	*C*	*C*		
S						*R*	*R*	*R*	*R*			
J					*C*	*C*	*A*	*A*	*A*	*C*		
L						*R*	*R*	*R*	*R*			
E						*R*	*R*	*R*	*R*			

Relative Abundance

H - Highly Abundant
A - Abundant
C - Common
R - Rare
Blank - Not Present
na - No Data Available

Life Stage

A - Adults
S - Spawning Adults
J - Juveniles
L - Larvae
E - Eggs

Source: Nelson *et al.* 1991, Jury *et al.* 1994, Stone *et al.* 1994.

Table 8 (continued). Temporal distribution and relative abundance of bluefish in Atlantic Coast estuaries.

Mid-Atlantic Estuaries

Estuary / Month	Life Stage	J	F	M	A	M	J	J	A	S	O	N	D
Great South Bay	A				*C*	*C*	*C*	*C*	*C*	*A*	*A*	*A*	*C*
	S												
	J				*C*	*A*	*A*	*A*	*A*	*A*	*C*	*R*	*R*
	L												
	E												
Hudson R./Raritan B.	A					*C*	*C*	*C*	*C*	*C*	*C*		
	S												
	J					*A*	*A*	*A*	*A*	*A*	*A*		
	L					*R*	*R*	*R*	*R*	*R*			
	E						*R*	*R*	*R*	*R*			
Barnegat Bay	A					*C*	*C*	*C*	*C*	*C*	*C*	*R*	
	S												
	J					*C*	*A*	*A*	*A*	*A*	*A*	*R*	
	L							*R*	*R*	*R*			
	E												
New Jersey Inland Bays	A					*C*	*C*	*C*	*C*	*C*	*C*	*R*	
	S												
	J					*C*	*A*	*A*	*A*	*A*	*A*	*R*	
	L												
	E												
Delaware Bay	A				*R*	*C*	*C*	*C*	*C*	*C*	*C*	*R*	
	S												
	J						*C*	*A*	*A*	*C*	*R*		
	L												
	E												
Delaware Inland Bays	A						*R*	*C*	*C*	*C*	*R*		
	S												
	J						*R*	*C*	*C*	*C*	*C*	*R*	
	L												
	E												
Chincoteague Bay	A					*C*	*C*	*C*	*C*	*C*	*C*	*R*	
	S												
	J					*C*	*C*	*C*	*C*	*C*	*C*	*R*	
	L												
	E												
Chesapeake B. Mainstem	A				*R*	*C*	*C*	*A*	*A*	*C*	*C*	*R*	
	S												
	J					*R*	*C*	*A*	*A*	*C*	*C*	*R*	
	L												
	E												
Chester River	A					*R*	*C*	*C*	*C*	*C*	*R*		
	S												
	J					*R*	*C*	*C*	*C*	*C*	*R*		
	L												
	E												
Choptank River	A					*R*	*C*	*C*	*C*	*C*	*R*		
	S												
	J					*R*	*C*	*C*	*C*	*C*	*C*		
	L												
	E												
Patuxent River	A					*R*	*C*	*C*	*C*	*C*	*R*		
	S												
	J					*R*	*C*	*C*	*C*	*C*	*R*		
	L												
	E												
Potomac River	A					*R*	*C*	*A*	*A*	*C*	*R*		
	S												
	J					*R*	*C*	*A*	*A*	*C*	*R*		
	L												
	E												
Tangier/Pocomoke Sd.	A				*R*	*C*	*C*	*A*	*A*	*C*	*R*	*R*	
	S												
	J					*R*	*C*	*A*	*A*	*C*	*R*	*R*	
	L												
	E												
Rappahannock River	A					*R*	*C*	*A*	*A*	*C*	*R*		
	S												
	J					*R*	*C*	*A*	*A*	*C*	*R*		
	L												
	E												

<u>Relative Abundance</u>

H - Highly Abundant
A - Abundant
C - Common
R - Rare
Blank - Not Present
na - No Data Available

<u>Life Stage</u>

A - Adults
S - Spawning Adults
J - Juveniles
L - Larvae
E - Eggs

Source: Nelson *et al.* 1991, Jury *et al.* 1994, Stone *et al.* 1994.

Table 8 (continued). Temporal distribution and relative abundance of bluefish in Atlantic Coast estuaries.

Region	Estuary / Month	Life Stage	J	F	M	A	M	J	J	A	S	O	N	D
Mid-Atlantic Estuaries	York River	A					*R*	*C*	*A*	*A*	*C*	*R*		
		S												
		J					*R*	*C*	*A*	*A*	*C*	*R*		
		L												
		E												
	James River	A					*R*	*C*	*A*	*A*	*C*	*R*		
		S												
		J					*R*	*C*	*A*	*A*	*C*	*R*		
		L												
		E												
Southeast Estuaries	Albemarle Sound	A						*C*	*C*	*C*	*C*	*C*		
		S												
		J					*C*	*C*	*C*	*C*	*C*	*C*		
		L												
		E												
	Pamlico Sound	A				*C*	*C*	*C*	*C*	*A*	*A*	*A*	*C*	
		S												
		J			*C*	*C*	*A*	*A*	*A*	*A*	*A*	*A*	*C*	
		L												
		E												
	Pamlico/Pungo Rivers	A					*C*	*C*	*C*	*C*	*C*	*C*	*C*	
		S												
		J					*C*	*C*	*C*	*C*	*C*	*C*		
		L												
		E												
	Neuse River	A					*R*	*R*	*R*	*R*	*R*	*R*	*R*	
		S												
		J			*C*	*C*	*C*	*C*	*C*					
		L												
		E												
	Bogue Sound	A							*A*	*A*	*A*	*A*	*A*	
		S												
		J			*C*	*C*	*C*	*A*	*A*	*A*	*A*	*C*	*C*	*C*
		L												
		E												
	New River	A												
		S												
		J			*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*
		L												
		E												
	Charleston Harbor	A												
		S												
		J			*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	
		L												
		E												
	St. Helena Sound	A	*C*	*C*										*C*
		S												
		J			*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	
		L												
		E												
	Broad River	A	*C*	*C*										*C*
		S												
		J			*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	
		L												
		E												

Relative Abundance

H - Highly Abundant
A - Abundant
C - Common
R - Rare
Blank - Not Present
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Life Stage

A - Adults
S - Spawning Adults
J - Juveniles
L - Larvae
E - Eggs

Source: Nelson *et al.* 1991, Jury *et al.* 1994, Stone *et al.* 1994.

Table 8 (continued). Temporal distribution and relative abundance of bluefish in Atlantic Coast estuaries.

Southeast Estuaries

Estuary / Month	Life Stage	J	F	M	A	M	J	J	A	S	O	N	D
Cape Fear River	A						*C*	*C*	*C*	*C*	*C*	*C*	
	S												
	J			*A*	*A*	*A*	*A*	*A*	*A*	*A*	*A*	*A*	
	L												
	E												
Winyah bay	A					*R*	*R*	*R*	*R*	*R*	*R*	*R*	
	S												
	J			*C*	*C*	*C*	*C*	*A*	*A*	*A*	*A*	*C*	
	L												
	E												
N/S Santee Rivers	A							*R*	*R*	*R*			
	S												
	J				*C*	*C*	*C*	*C*	*C*	*C*			
	L												
	E												
Savannah River	A												
	S												
	J	*C*	*R*	*R*	*R*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*
	L												
	E												
Ossabaw Sound	A												
	S												
	J	*C*	*R*	*R*	*R*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*
	L												
	E												
St. Cath/Sapelo Sound	A												
	S												
	J	*C*	*R*	*R*	*R*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*
	L												
	E												
Altamaha River	A												
	S												
	J	*C*	*R*	*R*	*R*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*
	L												
	E												
St. And./St. Sim. Sound	A												
	S												
	J	*C*	*R*	*R*	*R*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*
	L												
	E												
St. Johns River	A	*C*	*C*	*C*	*C*	*C*					*C*	*C*	*C*
	S												
	J	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*	*C*
	L												
	E												
Indian River	A	*H*	*H*	*A*	*A*	*A*	*C*	*C*	*C*	*C*	*H*	*H*	*H*
	S												
	J	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*
	L												
	E												
Biscayne Bay	A												
	S												
	J	*R*	*R*	*R*							*R*	*R*	*R*
	L												
	E												

Relative Abundance

H - Highly Abundant
A - Abundant
C - Common
R - Rare
Blank - Not Present
na - No Data Available

Life Stage

A - Adults
S - Spawning Adults
J - Juveniles
L - Larvae
E - Eggs

Source: Nelson *et al.* 1991, Jury *et al.* 1994, Stone *et al.* 1994.

Table 9a. Approximate area (percent and number of 10 minute squares) for the bluefish catch and area EFH alternatives, for bluefish eggs and larvae caught in the MARMAP ichthyoplankton survey. The logged catch alternative was not presented because the percent area and number of squares consistently fall between the catch and area alternatives. The preferred alternative is 90% of the area.

Bluefish Eggs

% Area	% Catch Index	Number of 10" Squares
0	0	0
7	50	6
10	75	8
20	90	16
50	92	40
75	96	60
90	98	72
100	100	80

Bluefish Larvae

% Area	% Catch Index	Number of 10" Squares
0	0	0
10	50	18
20	75	36
40	90	72
50	92	90
75	96	135
90	98	162
100	100	180

Source: Adapted from Cross pers. comm.

Table 9b. Approximate area (percent and number of 10 minute squares) for the bluefish catch and area EFH alternatives, for juvenile and adult bluefish caught in the NEFSC trawl survey. The logged catch alternative was not presented because the percent area and number of squares consistently fall between the catch and area alternatives. The preferred alternative is 90% of the area.

Juvenile Bluefish

% Area	% Catch Index	Number of 10" Squares
0	0	0
10	50	15
22	75	33
38	90	57
50	92	90
75	96	113
90	98	136
100	100	151

Adult Bluefish

% Area	% Catch Index	Number of 10" Squares
0	0	0
18	50	63
38	75	133
50	80	175
58	90	203
75	96	263
90	98	315
100	100	350

Source: Adapted from Cross pers. comm.

Table 10. Estuaries designated as essential fish habitat for juvenile and adult bluefish (mixing and seawater portions).

Juveniles		Adults	
Penobscot Bay, ME	Choptank River, MD	Penobscot Bay, ME	Patuxent River, MD
Muscongus Bay, ME	Patuxent River, MD	Muscongus Bay, ME	Potomac River, MD/VA
Damariscotta River, ME	Potomac River, MD/VA	Damariscotta River, ME	Tangier/Pocomoke Sound, VA
Sheepscot River, ME	Tangier/Pocomoke Sound, VA	Sheepscot River, ME	Rappahannock River, VA
Kennebec/Androscogin Rivers, ME	Rappahannock River, VA	Kennebec/Androscogin Rivers, ME	York River, VA
Casco Bay, ME	York River, VA	Casco Bay, ME	James River, VA
Saco Bay, ME	James River, VA	Saco Bay, ME	Albemarle Sound, NC
Wells Harbor, ME	Albemarle Sound, NC	Wells Harbor, ME	Pamlico Sound, NC
Great Bay, ME/NH	Pamlico Sound, NC	Great Bay, ME/NH	Pungo River, NC
Massachusetts Bay, MA	Pungo River, NC	Massachusetts Bay, MA	Bogue Sound, NC
Boston Harbor, MA	Neuse River, NC	Boston Harbor, MA	Cape Fear River, NC
Cape Cod, MA	Bogue Sound, NC	Cape Cod, MA	St. Helena sound, SC
Buzzards Bay, MA	New River, NC	Waquoit Bay, MA	Broad River, SC
Narragansett Bay, RI	Cape Fear River, NC	Buzzards Bay, MA	St. Johns River, FL
Connecticut River, CT	Winyah Bay, SC	Narragansett Bay, RI	Indian River, FL
Long Island Sound, NY	Santee Rivers (N&S), SC	Connecticut River, CT	
Gardiners Bay, NY	Charleston River, SC	Long Island Sound, NY	
Great South Bay, NY	St. Helena sound, SC	Gardiners Bay, NY	
Hudson River, Raritan/Sandy Hook Bays, NY/NJ	Broad River, SC	Great South Bay, NY	
Barnegat Bay, NJ	Savannah River, SC/GA	Hudson River, Raritan/Sandy Hook Bays, NY/NJ	
Great Bay, NJ	Ossabow Sound, GA	Barnegat Bay, NJ	
Southern Inland Bay, NJ	Sapelo Sound/St. Catherine, GA	NJ Inland Bays, NJ	
Delaware Bay, NJ/DE	Altamaha River, GA	Delaware Bay, NJ/DE	
Delaware Inland Bays, DE	St. Andrew/St. Simon Sound, GA	Delaware Inland Bays, DE	
Eastern Shore, MD/VA	St. Johns River, FL	Chesapeake Bay Mainstem, MD/VA	
Chesapeake Bay Mainstem, MD/VA		Chester River, MD	
Chester River, MD		Choptank River, MD	

Sources: Fahay 1998, Nelson *et al.* 1991, Jury *et al.* 1994, Stone *et al.* 1994.

Table 11. Comparisons of intensity and severity of various sources of physical disturbance to the seafloor (based on Hall 1994, Watling and Norse MS1997). Intensity is a measure of the force of physical disturbance and severity is the impact on the benthic community.

Source	Intensity	Severity
ABIOTIC		
Waves	Low during long temporal periods but high during storm events (to 70-80 m depth)	Low over long temporal periods since taxa adapted to these events but high locally depending on storm behavior
Currents	Low since bed shear normally lower than critical velocities for large volume and rapid sediment movement	Low since benthic stages rarely lost due to currents
Iceberg Scour	High locally since scouring results in significant sediment movement but low regionally	High locally due to high mortality of animals but low regionally
BIOTIC		
Bioturbation	Low since sediment movement rates are small	Low since infauna have time to repair tubes and burrows
Predation	Low on a regional scale but high locally due to patchy foraging	Low on a regional scale but high locally due to small spatial scales of high mortality
HUMAN		
Dredging	Low on a regional scale but high locally due to large volumes of sediment removal	Low on a regional scale but high locally due to high mortality of animals
Land Alteration (Causing silt laden runoff)	Low since sediment laden runoff per se does not exert a strong physical force	Low on a regional scale but high locally where siltation over coarser sediments causes shifts in associated communities
Fishing	High due to region wide fishing effort	High due to region wide disturbance of most types of habitat

Source: Auster and Langton 1998.

Table 12. Studies of the impacts of fishing gear on the structural components of fish habitat.

Habitat	Gear Type	Location	Results	Reference(s)
Eelgrass	Scallop dredge	North Carolina	Comparison of reference quadrats with treatments of 15 and 30 dredgings in hard sand and soft mud substrates within eelgrass meadows. Eelgrass biomass was significantly greater in hard sand than soft mud sites. Increased dredging resulted in significant reductions in eelgrass biomass and number of shoots.	Fonesca et al. (1984)
Eelgrass and shoalgrass	Clam rake and "clam kicking"	North Carolina	Comparison of effect of two fishing methods. Raking and "light" clam kicking treatments, biomass of seagrass was reduced approximately 25% below reference sites but recovered within one year. In "intense" clam kicking treatments, biomass of seagrass declined approximately 65% below reference sites. Recovery did not begin until more than 2 years after impact and biomass was still 35% below the level predicted from controls to show no effect.	Peterson et al. (1987)
Eelgrass and shoalgrass	Clam rakes (pea digger and bull rake)	North Carolina	Compared impacts of two clam rake types on removal of seagrass biomass. The bull rake removed 89% of shoots and 83% of roots and rhizomes in a completely raked 1 m2 area. The pea digger removed 55% of shoots and 37% of roots and rhizomes.	Peterson et al. (1983)
Seagrass	Trawl	western Mediter-ranean	Noted loss of *Posidonia* meadows due to trawling; 45% of study area. Monitored recovery of the meadows after installing artificial reefs to stop trawling. After 3 years plant density has increased by a factor of 6.	Guillen et al. (1994)
Sponge-coral hard-bottom	Roller-rigged trawl	off Georgia coast	Assessed effect of single tow. Damage to all species of sponge and coral observed; 31.7% of sponges, 30.4% of stony corals, and 3.9% of octocorals. Only density of barrel sponges (*Cliona* spp.) significantly reduced. Percent of stony coral damage high because of low abundance. Damage to other sponges, octocorals, and hard corals varied but changes in density not significantly different. No significant differences between trawled and reference sites after 12 months.	Van Dolah et al. (1987)
Sponge-coral hard-bottom	roller-frame shrimp trawl	Biscayne Bay, Florida	Damage to approximately 50% of sponges, 80% of stony corals, and 38% of soft corals.	Tilmant (1979) (cited in Van Dolah et al. 1987)

Source: Auster and Langton 1998.

Table 12 (continued). Studies of the impacts of fishing gear on the structural components of fish habitat.

Habitat	Gear Type	Location	Results	Reference(s)
Various tropical emergent benthos	Trawl	North West Shelf, Australia	Catch rates of all fish and large and small benthos show that in closed areas fish and small benthos abundance increased over 5 years while large benthos (>25 cm) stayed the same or increased slightly. In trawled areas all groups of animals declined. Found that settlement rate and growth to 25 cm was on the order of 15 years for the benthos.	Sainsbury et al. (In press)
Gravel pavement	Scallop dredge	Georges Bank	Assessed cumulative impact of fishing. Undredged sites had significantly higher percent cover of the tube-dwelling polychaete *Filograna implexa* and other emergent epifauna than dredged sites. Undredged sites had higher numbers of organisms, biomass, species richness, and species diversity than dredged sites. Undredged sites were characterized by bushy epifauna (bryozoans, hydroids, worm tubes) while dredged sites were dominated by hard-shelled molluscs, crabs, and echinoderms.	Collie et al. (1996, 1997)
Gravel-boulder	Assumed roller-rigged trawl	Gulf of Maine	Comparison of site surveyed in 1987 and revisited in 1993. Initially mud draped boulders and high density patches of diverse sponge fauna. In 1993, evidence of moved boulders, reduced densities of epifauna and extreme truncation of high density patches.	Auster et al. (1996)
Cobble-shell	Assumed trawl and scallop dredge	Gulf of Maine	Comparison of fished site and adjacent closed area. Statistically significant reduction in cover provided by emergent epifauna (e.g., hydroids, bryozoans, sponges, serpulid worms) and sea cucumbers.	Auster et al. (1996)
Gravel	Beam trawl	Irish Sea	An experimental area was towed 10 times. Density of epifauna (e.g., hydroids; soft corals, *Alcyonium digitatum*) was decreased approximately 50%.	Kaiser and Spencer (1996a)
Boulder-Gravel	Roller-rigged trawl	Gulf of Alaska	Comparisons of single tow trawled lane with adjacent reference lane. Significant reductions in density of structural components of habitat (two types of large sponges and anthozoans). No significant differences in densities of a small sponge and mobile invertebrate fauna. 20.1% boulders moved or dragged. 25% of ophiuroids (*Amphiophiura ponderosa*) in trawled lanes were crushed or damaged compared to 2% in reference lanes.	Freese et al. (In prep.)
Gravel over sand	Scallop dredge	Gulf of St. Lawrence	Assessed effects of single tows. Suspended fine sediments and buried gravel below the sediment-water interface. Overturns boulders.	Caddy (1973)

Source: Auster and Langton 1998.

Table 12 (continued). Studies of the impacts of fishing gear on the structural components of fish habitat.

Habitat	Gear Type	Location	Results	Reference(s)
Bryozoan beds (on sand and cobble)	Otter trawl and roller-rigged trawl	New Zealand	Qualitative comparison of closed and open areas. Two bryozoans produce "coral-like" forms and provide shelter for fishes and their prey. Comparisons of fished site with reference sites and prior observations from fishers show reduced density and size of colonies.	Bradstock and Gordon (1983)
Mussel bed	Otter trawl	Strangford Lough, Northern Ireland	Comparison of characteristics of trawled and untrawled *Modiolus modiolus* beds as pre and post impacts of a trawl. Trawled areas, confirmed with sidescan sonar, showed mussel beds disconnected with reductions in attached epibenthos. The most impacted sites were characterized by few or no intact clumps, mostly shell debris, and sparse epifauna. Trawling resulted in a gradient of complexity with flattened regions at the extreme. Immigration of *Nephrops* into areas previously dominated by *Modiolus* may result in burial of new recruits due to burrowing activities; precluding a return to a functional mussel bed habitat.	Magorrian (1995)
Sand-mud	Trawl and scallop dredge	Hauraki Gulf, New Zealand	Comparisons of 18 sites along a gradient of fishing effort (i.e., heavily fished sites through unfished reference sites). A gradient of increasing large epifaunal cover correlated with decreasing fishing effort.	Thrush et al. (In press)
Soft sediment	Scallop dredge	Port Phillip Bay, Australia	Compared reference and experimentally towed sites in BACI designed experiment. Bedforms consisted of cone shaped callianasid mounds and depressions prior to impact. Depressions often contained detached seagrasses and macroalgae. Only dredged plot changed after dredging. Eight days after dredging the area was flattened; mounds were removed and depressions filled. Most callianasids survived and density did not change in 3 mo following dredging. One month post impact, seafloor remained flat and dredge tracks distinguishable. Six months post impact mounds and depressions were present but only at 11 months did the impacted plot return to control plot conditions.	Currie and Parry (1996)
Sand	Beam trawl	North Sea	Observations of effects of gear. As pertains to habitat, trawl removed high numbers of the hydroid *Tubularia*.	DeGroot (1984)

Source: Auster and Langton 1998.

Table 12 (continued). Studies of the impacts of fishing gear on the structural components of fish habitat.

Habitat	Gear Type	Location	Results	Reference(s)
Gravel-sand-mud	Trawl	Monterey Bay	Comparison of heavily trawled (HT) and lightly trawled (LT) sites. The seafloor in the HT area had significantly higher densities of trawl tracks while the LT area had significantly greater densities of rocks >5 cm and mounds. The HT area had shell debris on the surface while the LT area had a cover of flocculent material. Emergent epifauna density was significantly higher for all taxa (anenomes, sea pens, sea whips) in the LT area.	Engel and Kvitek (MS1997)
Sand	Otter trawl	North Sea	Observations of direct effects of gear. Well buried boulders removed and displaced from sediment. Trawl doors smoothed sand waves. Penetrated seabed 0-40 mm (sand and mud).	Bridger (1970, 1972)
Sand-shell	Assumed trawl and scallop dredge	Gulf of Maine	Comparison of fished site and adjacent closed area. Statically significant reduction of habitat complexity based on reduced cover provided by biogenic depressions and sea cucumbers. Observations at another site showed multiple scallop dredge paths resulting in smoothed bedforms. Scallop dredge paths removed cover provided by hydrozoans which reduced local densities of associated shrimp species. Evidence of shell aggregates dispersed by scallop dredge.	Auster et al. (1996)
Sand-silt to mud	Otter trawl with chain sweep and roller gear	Long Island Sound	Diver observations showed doors produced continuous furrows. Chain gear in wing areas disrupted amphipod tube mats and bounced on bottom around mouth of net, leaving small scoured depressions. In areas with drifting macroalgae, the algae draped over grounder of net during tows and buffered effects on the seafloor. Roller gear also created scoured depressions. Spacers between discs lessened impacts.	Smith et al. 1985

Source: Auster and Langton 1998.

Table 13. Studies of short-term impacts of fishing on benthic communities.

Taxa	Gear and Sediment Type	Region	Results	Reference(s)
Infauna	beam trawl; megaripples and flat substrate	Irish Sea, U.K.	Assessed at the immediate effects of beam trawling and found a reduction in diversity and abundance of some taxa in the more stable sediments of the northeast sector of their experimental site but could not find similar effects in the more mobile sediments. Out of the top 20 species 19 had lower abundance levels at the fished site and nine showed a statistically significant decrease. Coefficient of variation for numbers and abundance was higher in the fished area of the NW sector supporting the hypothesis that heterogeneity increases with physical disturbance. Measured a 58% decrease in mean abundance and a 50% reduction in the mean number of species per sample in the sector resulting from removal of the most common species. Less dramatic change in the sector where sediments are more mobile.	Kaiser and Spencer (1996a)
Starfish	beam trawl; coarse sand, gravel and shell, muddy sand, mud	Irish Sea, U.K.	Evaluated damage to starfish at three sites in the Irish sea that experienced different degrees of trawling intensity. Used ICES data to select sites and used side scan to confirm trawling intensity. Found a significant correlation between starfish damage (arm regeneration) and trawling intensity.	Kaiser (1996)
Horse mussels	otter trawl; horse mussel beds,	Strangford Lough; N. Ireland	Used video/rov, side scan and benthic grabs to characterize the effect of otter trawling and scallop dredging on the benthic community. There was special concern over the impact on *Modiolus* beds in the Lough. Plotted the known fishing areas and graded impacts based on a subjective 6 point scale; found significant trawl impacts. Side scan supported video observations and showed areas of greatest impact. Found that in otter trawl areas that the otter boards did the most damage. Side scan suggested that sediment characteristics had changed in heavily trawled areas.	Industrial Science Division. (1990)
Benthic fauna	beam trawl; mobile megaripples structure and stable uniform sediment	Irish Sea, U.K.	Sampled trawled areas 24 hours after trawling and 6 months later. On stable sediment found significant difference immediately after trawling. Reduction in polychaetes but increase in hermit crabs. After six months there was no detectable impact. On megaripples substrate no significant differences were observed immediately after trawling or 6 months later.	Kaiser et al MS 1997

Source: Auster and Langton 1998.

Table 13 (continued). Studies of short-term impacts of fishing on benthic communities.

Taxa	Gear and Sediment Type	Region	Results	Reference(s)
Bivalves, sea scallop, surf clams, ocean quahog	scallop dredge, hydraulic clam dredge; various substrate types	Mid-Atlantic Bight, USA	Submersible study of bivalve harvest operations. Scallops harvested on soft sediment (sand or mud) had low dredge induced mortality for uncaught animals (<5%). Culling mortality (discarded bycatch) was low, approx. 10%. Over 90% of the quahogs that were discarded reburrowed and survived whereas 50% of the surf clams died. Predators crabs, starfish, fish and skates, moved in on the quahogs and clams in the predator density 10 items control area levels within 8 hours post dredging. Noted numerous "minute" predators feeding in trawl tracks. Non-harvested animals, sand dollars, crustaceans and worms significantly disrupted but sand dollars suffered little apparent mortality.	Murawski and Serchuck (1989)
Ocean quahog	hydraulic clam dredge;	Long Island, N.Y., USA	Evaluated clam dredge efficiency over a transect and changed up to 24 hours later. After dredge fills it creates a "windrow of clams". Dredge penetrates up to 30 cm and pushes sediment into track shoulders. After 24 hours track looks like a shallow depression. Clams can be cut or crushed by dredge with mortality ranging from 7 to 92 %, being dependent on size and location along dredge path. Smaller clams survive better and are capable of reburrowing in a few minutes. Predators, crabs, starfish and snails, move in rapidly and depart within 24 hours.	Meyer et al. (1981)
Macro-benthos	scallop dredge; coarse sand	Mercury Bay, New Zealand	Benthic community composed of small short-lived animals at two experimental and adjacent control sites. Sampling before and after dredging and three months later. Dredging caused an immediate decrease in density of common macrofauna. Three months later some populations had not recovered. Immediate post-trawling snails, hermit crabs and starfish were feeding on damaged and exposed animals	Thrush et al. (1995)
Scallops and associated fauna	scallop dredge; "soft sediment"	Port Phillip Bay, Australia	Sampled twice before dredging and three times afterwards, up to 88 days later. The mean difference in species number increased from 3 to 18 after trawling. The total number of individuals increased over the sampling time on both experimental and control primarily as a result of amphipod recruitment, but the number of individuals at the dredged sites were always lower than the control. Dissimilarity increased significantly, as a result of dredging, because of a decrease in species numbers and abundance.	Currie and Parry (1994)

Source: Auster and Langton 1998.

Table 13 (continued). Studies of short-term impacts of fishing on benthic communities.

Taxa	Gear and Sediment Type	Region	Results	Reference(s)
Sea Scallops and associated fauna	otter trawl and scallop dredge; gravel and sand	Gulf of St. Lawrence, Canada	Observed physical change to sea floor from otter doors and scallop dredge and lethal and nonlethal damage to the scallops. Noted an increase in the most active predators within the trawl tracks compared to outside; winter flounder, sculpins and rock crabs. No increase in starfish or other sedentary forms within in an hour of dredging.	Caddy (1973)
Macrofauna	beam trawl; hard-sandy substrate	North Sea, coast of Holland	Sampling before and after beam trawling (*hrs, 16 hrs and 2 weeks) showed species specific changes in macrofaunal abundance. Decreasing density ranged from 10 to 65% for species of echinoderms (starfish and sea urchins but not brittle stars), tube dwelling polychaetes and molluscs at the two week sampling period. Density of some animals did not change others increased but these were not significant after 2 weeks.	Bergman and Hup (1992)
Benthic fauna	beam trawl and shrimp trawl; hard sandy bottom, shell debris and sandy-mud	North Sea, German coast	Preliminary report using video and photographs comparing trawled and untrawled areas. Presence and density of brittle stars, hermit crabs, other "large" crustaceans and flatfish was higher in the controls than the beam trawl site. Difference in sand ripple formation in trawled areas was also noted, looking disturbed not round and well developed. Found a positive correlation with damage to benthic animals and individual animal size. Found less impact with the shrimp trawl, diver observations confirmed low level of impact although the net was "festooned" with worms. Noted large megafauna, mainly crabs, in trawl tracks.	Rumhor et al. (1994)
Soft bottom macrofauna	beam trawl; very fine sand	North Sea, Dutch Sector	Compared animal densities before and after trawling and looked at fish stomach contents. Found that total mortality due to trawling varied between species and size class of fish, ranging from 4 to 139% of pretrawling values. (values> 100% indicate animals moving into the trawled area). Mortality for echinoderms was low, 3 to 19%, undetectable for some molluscs, esp. solid shells or small animals, while larger molluscs had a 12 to 85% mortality. Burrowing crustaceans had low mortality but epifaunal crustaceans approximated 30 % but ranged as high as 74%. Annelids were generally unaffected except for Pectinaria, a tube building animal. Generally mortality increased with number of times the area was trawled (once or twice). Dab were found to be the major savager, immigrating into the area and eating damaged animals.	Santbrink and Bergman (1994)

Source: Auster and Langton 1998.

Table 13 (continued). Studies of short-term impacts of fishing on benthic communities.

Taxa	Gear and Sediment Type	Region	Results	Reference(s)
Hermit Crabs	beam trawl	Irish Sea, U.K.	Compared the catch and diet of two species of hermit crab on trawled and control sites. Found significant increases in abundance on the trawl lines two to four days after trawling for both species but also no change for one species on one of two dates. Found a general size shift towards larger animals after trawling. Stomach contents weight was higher post-trawling for one species. Diets of the crabs were similar but proportions differed.	Ramsey et al. (1996)
Sand macrofauna and infauna	scallop dredge	Irish Sea	Compared experimental treatments based frequency of tows (i.e., 2,4,12,25). Bottom topography changes did not change grain size distribution, organic carbon, or chlorophyll content. Bivalve molluscs and peracarid crustaceans did not show significant changes in abundance or biomass. Polychaetes and urchins showed significant declines. Large molluscs, crustaceans and sand eels were also damaged. In general, there was selective elimination of fragile and sedentary components of the infauna as well as large epifaunal taxa.	Eleftheriou and Robertson (1992)

Source: Auster and Langton 1998.

Table 14. Studies of long-term impacts of fishing on benthic communities.

Habitat Type and Taxa Present	Time Period	Location	Effect	Reference
Sand; macrobenthos and meiofauna	2-7 months	Bay of Fundy	Experimental trawling in high energy area. Otter trawl doors dug up to 5 cm deep and marks were visible for 2 to 7 months. Initial significant effects on benthic diatoms and nematodes but no significant impact on macrofauna. No significant longterm effects.	Brylinsky et al. (1994)
Quartz sand; benthic infauna	5months	South Carolina Estuary	Compared benthic community in two areas, one open to trawling one closed, before and after shrimp season. Found variation with time but no relationship between variations and trawling per se.	Van Dolah et al. (1991)
Sandy; ocean quahogs	----	Western Baltic	Observed otter board damage to bivalves, especially ocean quahogs, and found an inverse relation between shell thickness and damage and a positive correlation between shell length and damage.	Rumhor and Krost (1991)
Subtidal shallows and channel; macrobenthos	100 years	Wadden Sea	Reviewed changes in benthic community documented over 100 years. Considered 101species. No long term trends in changing abundance for 42 common species, with 11 showing considerable variation. Sponges, coelenterates and bivalves suffered greatest losses while polychaetes showed the largest gains. Decrease subtidally for common species from 53 to 44 and increase intertidally from 24 to 38.	Reise (1982)
Intertidal sand; lug worms	4 years	Wadden Sea	Studied impact of lugworm harvesting versus control site. Machine digs 40 cm gullies. Immediate impact is a reduction in several benthic species and slow recovery for some the larger long-lived species like soft shelled clams. With one exception, a polychaete, the shorter-lived macrobenthic animals showed no decline. It took several years for the area to recover to prefishing conditions.	Beukema (1995)
Various habitat types; all species	---	North Sea	Review of fishing effects on the North Sea based primarily on ICES North Sea Task Force reports. Starfish, sea urchins and several polychaetes showed a 40 to 60 % reduction in density after beam trawling but some less abundant animals showed no change and one polychaete increased. At the scale of the North Sea the effect of trawling on the benthos is unclear.	Gislason (1994)

Source: Auster and Langton 1998.

Table 14 (continued). Studies of long-term impacts of fishing on benthic communities.

Habitat Type and Taxa Present	Time Period	Location	Effect	Reference
Sand; macrofauna	73 years	Kattegatt	Compared benthic surveys form 1911-1912 with 1984. Community composition has changed with only approximately 30% similarity between years at most stations. Primary change was a decrease in sea urchins and increase in brittle stars. Animals were also smaller in 1984. Deposit feeders have decreased while suspension feeders and carnivores have increased.	Pearson et al. (1985)
Subtidal shallows and channels; Macrofauna	55 years	Wadden Sea, Germany	Documented increase in mussel beds and associated species such as polychaetes and barnacles when comparing benthic survey data. Noted loss of oyster banks, *Sabellaria* reefs and subtidal sea grass beds. Oysters were overexploited and replaced by mussels; *Zostera* lost to disease. Conclude that major habitat shifts are the result of human influence.	Riesen and Reise (1982)
146 stations; Ocean Quahogs	---	Southern North Sea, Europe	Arctica valves were collected from 146 stations in 1991 and the scars on the valve surface were dated, using internal growth bands, as an indicator of the frequency of beam trawl damage between 1959 and 1991. Numbers of scars varied regionally and temporally and correlated with fishing.	Witbaard and Klein (1994)
Various habitats; Macrofauna	85 years	Western English Channel, UK	Discusses change and causes of change observed in benthic community based on historic records and collections. Discusses effects of fishing gear on dislodging hydroid and bryozoan colonies, and speculates that effects reduce settlement sites for queen scallops.	Holme (1983)
Gravel/sand; Macrofauna	3 years	Central California, USA	Compared heavily trawled area with lightly trawled (closed) area using Smith MacIntyre grab samples and video transect data collected over three years. Trawl tracks and shell debris were more numerous in heavily trawled area, as were amphinomid polychaetes and oligochaetes in most years. Rocks, mounds and flocculent material were more numerous at the lightly trawled station. Commercial fish were more common in the lightly trawled area as were epifaunal invertebrates. No significant differences were found between stations in term of biomass of most other invertebrates.	Engel and Kvitek (MS 1997)
Fine sand; razor clam	----	Barrinha, Southern Portugal	Evaluated disturbance lines in shell matrix of the razor clam and found an increase in number of disturbance lines with length and age of the clams. Sand grains were often incorporated into the shell suggestive of a major disturbance , such as trawling damage, and subsequent recovery and repair of the shell.	Gaspar et al. (1994)

Source: Auster and Langton 1998.

Table 14 (continued). Studies of long-term impacts of fishing on benthic communities.

Habitat Type and Taxa Present	Time Period	Location	Effect	Reference
Fine to medium sand; ocean quahogs	----	Southern New Jersey, USA	Compared areas unfished, recently fished and currently fished for ocean quahogs using hydraulic dredges. Sampled invertebrates with a Smith MacIntyre grab. Few significant differences in numbers of individuals or species were noted, no pattern suggesting any relationship to dredging.	MacKenzie (1982)
Gravel, shell debris and fine mud; Horse mussel community	8 years	Strangford Lough, Northern Ireland	Review paper of effects of queen scallop fishery on the horse mussel community. Compared benthic survey from the 1975-80 period with work in 1988. Scallop fishery began in 1980. *Modiolus* community has remained unchanged essentially from 1857 to 1980. The scallop fishery has a large benthic faunal bycatch, including horse mussels. Changes in the horse mussel community are directly related to the initiation of the scallop fishery and there is concern about the extended period it will take for this community to recover.	Brown (1989)
Shallow muddy sand; scallops	6 months	Maine, USA	Sampled site before, immediately after and up to 6 months after trawling. Loss of surficial sediments and lowered food quality of sediments, measured as microbial populations, enzyme hydrolyzable amino acids and chlorophyll *a*, was observed. Variable recovery by benthic community. Correlation with returning fauna and food quality of sediment.	Watling et al. (MS 1997)
Sand and seagrass; hard shelled clams and bay scallops	4 years	North Carolina, USA	Evaluated effects of clam raking and mechanical harvesting on hard clams, bay scallops, macroinvertebrates and seagrass biomass. In sand, harvesting adults showed no clear pattern of effect. With light harvesting seagrass biomass dropped 25% immediately but recovered in a year. In heavy harvesting seagrass biomass fell 65% and recovery did not start for >2 years and did not recover up to 4 years later. Clam harvesting showed no effect on macroinvertebrates. Scallop densities correlated with seagrass biomass.	Peterson et al. (1987)
Gravel pavement; benthic magafauna	Not known	Northern Georges Bank, USA	Used side scan, video and naturalist dredge sampling to characterize disturbed and undisturbed sites based on fishing activity records. Documented a gradient of community structure from deep, undisturbed to shallow disturbed sites. Undisturbed sites had more individual organisms, greater biomass, greater species richness and diversity and were characterized by an abundant bushy epifauna. Disturbed sites were dominated by hard-shelled molluscs, crabs and echinoderms.	Collie et al. (1997)

Source: Auster and Langton 1998.

Table 14 (continued). Studies of long-term impacts of fishing on benthic communities.

Habitat Type and Taxa Present	Time Period	Location	Effect	Reference
Sand; epifauna	3 year	Grand Banks, Canada	Experimentally trawled site 12 times each year within 31 to 34 hours for three years. Total invertebrate bycatch biomass declined over the three year study in trawls. Epibenthic sled samples showed lower biomass, averaging 25%, in trawled areas than reference sites. Scavenging crabs were observed in trawl tracks after first 6 hours and trawl damage to brittle stars and sea urchins was noted. No significant effects of trawling were found for four dominant species of mollusc.	Prena et al. (MS 1997)
Sand, shrimp and macrobenthos	7 months	New South Wales, Australia	Sampled macrofauna, pretrawling, after trawling and after commercial shrimp season using Smith McIntyre grab at experimental and control sites. Under water observation of trawl gear were also made. No detectable changes in macrobenthos was found or observed.	Gibbs et al. (1980)
Soft sediment; scallops and associated fauna	17 months	Port Phillip Bay, Australia	Sampled 3 months before trawling and 14 months after trawling. Most species showed a 20 to 30% decrease in abundance immediately after trawling. Dredging effects generally were not detectable following the next recruitment within 6 months but some animals had not returned to the trawling site 14 months post trawling.	Currie and Parry (1996)
Bryozoans; fish and associated fauna	----	Tasman Bay, New Zealand	Review of ecology of the coral-like bryozoan community and changes in fishing gear and practices since the 1950s. Points out the interdependence of fish with this benthic community and that the area was closed to fishing in 1980 because gear had developed which could fish in and destroy the benthic community thereby destroying the fishery.	Bradstock and Gordon (1983)
Various habitat types; diverse tropical fauna	5+years, ongoing	North West Shelf, Australia	Describes a habitat dependent fishery and an adaptive management approach to sustaining the fishery. Catch rates of all fish and large and small benthos show that in closed areas fish and small benthos abundance increased over 5 years while large benthos (>25 cm) stayed the same or increased slightly. In trawled areas all groups of animals declined. Found that settlement rate and growth to 25 cm was on the order of 15 years for the benthos.	Sainsbury et al. (In press)

Source: Auster and Langton 1998.

Table 14 (continued). Studies of long-term impacts of fishing on benthic communities.

Habitat Type and Taxa Present	Time Period	Location	Effect	Reference
Mudflat; commercial clam cultivation and benthos	7 months	South-east England	Sampled benthic community on a commercial clam culture site and control area at the end of a two year growing period, immediately after sampling, and again 7 months later. Infaunal abundance was greatest under the clam culture protective netting but species composition was similar to controls. Harvesting with a suction dredge changed the sediment characteristics and reduced the numbers of individual animals and species. Seven months later the site had essentially returned to the unharvested condition.	Kaiser et al. (1996a)
Sand; razor clam and benthos	40 days	Loch Gairloch, Scotland	Compared control and experimentally harvested areas using a hydraulic dredge at 1 day and 40 days after dredging. On day one a non-selective reduction in the total numbers of all infaunal species was apparent but no differences were observed after forty days.	Hall et al. (1990)
Sand and muddy areas; Macro-zoobenthos	3years; ongoing	German Bite, Germany	Investigated macro-zoobenthos communities around a sunken ship that had been "closed" to fishing for three years. Compared this site with a heavily fished area. Preliminary results show an increase in polychaetes and the bivalve Tellina in the fished, sandy, area. The data does not yet allow for a firm conclusion regarding the unfished area but there is some (nonsignificant) increase in species numbers and some delicate, sensitive species occurred within the protected zone.	Arntz et al. (1994)

Source: Auster and Langton 1998.

Table 15. Total commercial landings in millions of pounds by gear type from Maine to Virginia, in 1995.

GEAR TYPE	X 10^6 POUNDS	% OF TOTAL
PURSE SEINE, MENHADEN	739	44.90%
TRAWL, OTTER, BOTTOM	249	15.12%
UNKNOWN	142	8.60%
DREDGE, CLAM	118	7.17%
PURSE SEINE, HERRING	76	4.63%
POT/TRAP, LOBSTER	71	4.32%
TRAWL, OTTER, MIDWATER	69	4.25%
GILL NET, SINK, OTHER	58	3.55%
DIVING GEAR	28	1.70%
DREDGE, SCALLOP, SEA	22	1.32%
POTS + TRAPS, OTHER	21	1.28%
DREDGE, OTHER	17	1.02%
OTHER	14	0.82%
LONGLINE, BOTTOM	10	0.62%
LONGLINE, PELAGIC	6	0.36%
GILL NET, OTHER	3	0.19%
POUND NET	2	0.13%
PURSE SEINE, OTHER	1	0.04%
GRAND TOTAL	1650	100.00%

Source: USDC weighout file 1995.

Table 16. Fishing gear used to catch more than 1% of the total landings of the Mid-Atlantic Council-managed species, in 1995.

Species \ Gear	Dredge, Scallop Sea	Dredge, SC/OQ	Floating Traps, Shallow	Gill Nets, Drift, Other	Gill Nets Sink, Other	Lines, Hand, Other	Lines, Long, Bottom	Otter Trawl, Bottom, Fish	Otter, Trawl, Bottom, Other	Pots and Traps, Fish	Pots and Traps, Lobster, Inshore	Pots and Traps, Lobster, Offshore	Pound Nets, Fish	Pound Nets, Other	Unknown
Atlantic Mackerel			X		X			X	X					X	
Black Sea Bass						X		X		X	X	X			X
Bluefish			X	X	X	X		X					X	X	X
Butterfish								X							X
Illex								X							
Loligo								X							
Ocean Quahog		X													
Scup			X					X		X	X	X			X
Spiny Dogfish					X		X	X							
Summer Flounder	X							X	X					X	X
Surfclam		X													

Table 17. Fishing gear managed by South Atlantic Fishery Management Council.

Gear Impacts and Council Action
Gear Used in Fisheries Under South Atlantic Council Fishery Management Plans

The following is a list of gear currently in use (or regulated) in fisheries managed under the South Atlantic Council fishery management plans. In general, if gear is not listed, it is prohibited or not commonly used in the fishery:

Snapper Grouper Fishery Management Plan

1. Vertical hook-and-line gear, including hand-held rod and manual or electric reel or "bandit gear" with manual, electric or hydraulic reel (recreational and commercial).

2. Spear fishing gear including powerheads (recreational and commercial).

3. Bottom longlines (commercial).
   - Prohibited south of a line running east of St. Lucie Inlet, Florida and in depths less than 50 fathoms north of that line.
   - May not be used to fish for wreckfish.

4. Sea bass pots (commercial).
   - May not be used or possessed in multiple configurations.
   - Pot size, wire mesh size and construction restrictions.
   - May not be used in the EEZ south of a line running due east of the NASA Vehicle Assembly Building, Cape Canaveral, Florida.

5. Special Management Zones (created under the Snapper Grouper FMP).
   - Sea bass pots are prohibited in all Special Management Zones.
   - Fishing may only be conducted with hand-held hook-and-line gear (including manual, electric, or hydraulic rod and reel) and spearfishing gear in specified Special Management Zones, however, and other specified Special Management Zones a hydraulic or electric real that is permanent affixed to a vessel ("bandit gear") and or spear fishing gear (or only powerheads) are prohibited.

Shrimp Fishery Management Plan

1. Shrimp trawls -- wide-ranging types including otter trawls, mongoose trawls, rock shrimp trawls, etc. (commercial).
   - Specified areas are closed to trawling for rock shrimp.

Red Drum Fishery Management Plan

1. No harvest or possession is allowed in or from the EEZ (no gear specified).

Golden Crab Fishery Management Plan

1. Crab traps (commercial).
   - May not be fished in water depths less than 900 feet in the northern zone and 700 feet in the middle and southern zones.
   - Trap size, wire mesh size, and construction restrictions.

Coral, Coral Reefs, and Live/Hard Bottom Habitat

1. Hand harvest only for allowable species (recreational and commercial).
2. Oculina Bank Habitat Area of particular concern.
   - Fishing with bottom longlines, bottom trawls, dredges, ports, or traps is prohibited.
   - Fishing vessels may not anchor, use and anchor and chain, or use a grapple and chain.

Coastal Migratory Pelagic Resource Fishery Management Plan

1. Hook-and-line gear, usually rod and reel or bandit gear, hand lines, flat lines, etc. (recreational and commercial).
2. Run-around gillnets or sink nets (commercial).
   - A gillnet must have a float line less than 1,000 yards in length to fish for coastal migratory pelagic species.
   - Gillnets must be at least 4-3/4 inch stretch mesh.
3. Purse seines for other coastal migratory species (commercial) with an incidental catch allowance for Spanish mackerel (10%) and king mackerel (1%).
4. Surface longlines primarily for dolphin.

Source: SAFMC 1998

Table 18. Proposed impact of fishing gear on bluefish EFH.

GEAR TYPE	KNOWN IMPACT	POTENTIAL IMPACT	NONE EXPECTED
PURSE SEINE, MENHADEN			X
TRAWL, OTTER, BOTTOM		X	
UNKNOWN			X
DREDGE, CLAM		X	
PURSE SEINE, HERRING			X
POT/TRAP, LOBSTER		X	
TRAWL, OTTER, MIDWATER			X
GILL NET, SINK, OTHER		X	
DIVING GEAR			X
DREDGE, SCALLOP, SEA		X	
POTS + TRAPS, OTHER		X	
DREDGE, OTHER		X	
OTHER			X
LONGLINE, BOTTOM			X
LONGLINE, PELAGIC			X
GILL NET, OTHER		X	
POUND NET			X
PURSE SEINE, OTHER			X

Table 19. Matrix of prioritized threats in regards to their potential impact to bluefish EFH along the Atlantic coast.

	IMPACTS																								
Threat	A. Change in Topography	B. Fish Blockage	C. Wetland alteration	D. Loss of SAV	E. Loss of riparian habitat	F. Erosion	G. Change in nature of substratight	H. Suspended sediments, turbidity	I. Change in temperature regime	J. Change in salinity regime	K. Change in circulation pattern	L. Hypoxia / Anoxia	M. Nutrient loading, Eutrophication	N. Change in photosynthesis regime	O. Water contamination	P. Sediment contamination	Q. Litter	R. Atmospheric Deposition	S. Loss in benthic organisms	T. Physical damage to organism	U. Gene pool deterioration	V. Trophic alteration	W. Pathogens, disease	X. Displacement of Species	Y. Introduction of exotic species
1.0 Coastal Development	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*					*	
2.0 Nonpoint Source Pollution	*			*			*	*	*	*	*	*	*	*	*	*	*	*	*				*	*	
3.0 Dredging and Dredge Spoil Placement	*		*	*			*	*			*	*		*	*	*			*	*			*	*	
4.0 Port Development, Utilization, and Shipping	*		*				*	*				*		*	*	*		*	*	*				*	*
5.0 Marinas and Recreational Boating			*	*		*	*	*	*	*		*			*	*	*	*	*	*			*	*	*
6.0 Energy Production and Transport		*	*				*	*	*	*	*				*	*		*		*				*	
7.0 Sewage Treatment and Disposal			*				*	*	*			*	*	*	*	*			*				*	*	
8.0 Industrial Wastewater and Solid Wastes		*	*				*		*	*			*	*	*	*				*				*	
9.0 Marine Mining	*		*	*		*	*	*				*		*					*					*	
10.0 Aquaculture	*	*	*	*		*	*						*								*		*	*	*
11.0 Ocean Disposal							*	*				*	*	*	*	*							*	*	
12.0 Introduced Species	*			*				*													*	*	*	*	

Table 20. Physical characteristics and nutrient loadings for eight major Mid-Atlantic estuaries.

Location	Volume (cubic ft.)	Surface Area (sq. mi.)	Average Daily Inflow (cfs)	Total Drainage Area (sq. mi.)	Estimated Nitrogen Loadings (tons/yr.)	Estimated Phosphorus Loadings (tons/yr.)
Delaware Bay	4.48×10^{11}	768	19,800	13,450	50,199 (High)	13,109 (High)
Delaware Inland Bays	3.85×10^{9}	33.3	300	292	1,425 (Med-High)	82 (Med.)
Chincoteague Bay	2.25×10^{10}	137	400	300	292 (Low)	84 (Low)
Chesapeake Bay	2.59×10^{12}	3,830	85,800	69,280	119,929 (High)	16,813 (High)
Albemarle-Pamlico Sound	1.08×10^{12}	2,949	46,000	29,574	28,224 (High)	3,565 (High)
Bogue Sound	1.31×10^{10}	102	1,300	680	710 (Low)	56 (Low)
New River	5.18×10^{9}	32	800	470	616 (Low)	112 (Med.)
Cape Fear River	1.22×10^{10}	38	10,100	9,090	8,102 (Med.)	1,486 (High)

Source: Cooper and Lipton 1994.

Table 21. Recent trends in selected parameters characterizing eutrophication, by estuary.

Parameter		St. Croix R./Cobscook Bay		Englishman Bay		Narraguagus Bay		Blue Hill Bay		Penobscot Bay			Muscongus Bay		Damadscotta River		Sheepscot Bay		
		M	S	M	S	M	S	M	S	T	M	S	M	S	M	S	T	M	S
CHLOROPHYLL *A* (pg/1)		●	●	?	?	?	?	?	●	?	?	?	?	●	?	●	?	●	●
TURBIDITY		V•	●	?	Λ	?	?	?	●	?	?	?	?	?	?	●	●	●	●
NUISANCE ALGAE	*event duration*	●	●	?	?	?	?	?	?	?	●	●	?	?	?	●	●	●	●
	frequency of occurrence	●	●	?	?	?	?	?	?	?	●	●	?	?	●	●	●	●	●
TOXIC ALGAE	*event duration*	●	●	?	●	?	●	?	●	?	●	●	?	?	?	●	●	●	●
	frequency of occurrence	●	●	?	●	?	?	?	●	?	●	●	?	?	●	●	●	●	●
MACROALGAL		Λ		?	Λ	?	?	?	●	?	?	?	●	●	?	●	●	●	●
EPIPHYTE ABUNDANCE		?	●	?	?	?	?	?	?	?	?	?	●	●	●	●	●	●	●
NITROGEN (mg/1)		●	●	?	●	?	?	●	●	?	V•	●	?	●	●	●	●	●	●
PHOSPHORUS (mg/1)		●	●	?	?	?	?	●	●	●	●	●	?	●	●	●	●	●	●
BOTTOM DO (mg/1)		Λ	●	?		?	?	●	●	Λ	Λ	●	●	●	●	●	Λ•	?	●
ANOXIA	*event duration*	?	●	?	?	?	?	●	●	V	V	●	●•	?	●	●	?	?	●
	frequency of occurrence	?	●	?	?	?	?	●	●	V	V	●	●•	?	●	●	?	?	?
	spatial coverage	?	●	?	?	?	?	●	●	V	V	●	●•	?	●	●	?	?	●
HYPOXIA	*event duration*	?	●	?	?	?	?	●	●	V	V	●	●•	?	●	●	?	?	●
	frequency of occurrence	?	●	?	?	?	?	●	●	V	V	●	●•	?	●	●	?	?	?
	spatial coverage	?	●	?	?	?	?	●	●	V	V	●	●•	?	●	●	?	?	●
BIOLOGICAL STRESS	*event duration*	?	●	?	?	?	?	●	●	V	V	●	●•	?	●	●	?	?	●
	frequency of occurrence	?	●	?	?	?	?	●	●	V	V	●	●•	?	●	●	?	?	?
	spatial coverage	?	●	?	?	?	?	●	●	V	V	?	●•	?	●	●	?	?	●
PRIMARY PRODUCTIVITY		●•	●•	?	?	?	?	●	●	?	?	?	?	?	●•	●•	?	●	●
PLANKTONIC COMMUNITY		?	●	?		?	?	?	●	?	?	?	?	?	●	●	?	●	●
BENTHIC COMMUNITY		?	●	?		?	?	?	●	?	●	●	?	?	●	●	●	●	●
SAV (spatial coverage)		●	Λ	?	?	?	?	●	●	?	?	?	?	?	●	●•	?	?	?

Parameter		Kennebec/Andro River			Casco Bay		Saco Bay		Great Bay		Hampton Harbor		Merdmack River		Plum Island Sound		Massachusetts Bay	Boston Harbor		Cape Cod Bay
		T	M	S	M	S	M	S	M	S	M	S	T	M	M	S	S	M	S	S
CHLOROPHYLL *A* (pg/1)		?	?	?	●	●	●	●	●	●	?	?	?	?	●	●	●	?	●	●
TURBIDITY		?	?	?	V	●	?	?	●	●	?	?	?	?	●	●	●	●	●	●
NUISANCE ALGAE	*event duration*	?	?	?	●	●	●	●	●	●	●	●	?	?	●	●	●	?	?	●
	frequency of occurrence	?	?	?	●	●	●	●	●	●	●	●	?	?	●	●	●	?	?	●
TOXIC ALGAE	*event duration*	?	?	?	●	●	●	●	●	●	●	●	?	?	●	●	●	?	?	●
	frequency of occurrence	?	?	?	●	●	●	●	●	●	●	●	?	?	●	●	●	?	?	●
MACROALGAL		?	?	?	●	Λ•	?	?	Λ•	Λ•	●	●	?	?	?	?	Λ	?	Λ•	Λ
EPIPHYTE ABUNDANCE		?	?	?	●	●	?	?	●•	●•	●	●	?	?	?	?	●	?	?	●
NITROGEN (mg/1)		?	?	?	●	●	●	●	●	●	?	?	?	?	●	●	●	?	●	Λ•
PHOSPHORUS (mg/1)		?	?	?	●	●	●	●	V	●	?	?	?	?	●	●	●	?	●	●
BOTTOM DO (mg/1)		?	?	?	Λ	Λ	Λ	●	●	●	?	?	?	?	●	●	●	?	●	V•
ANOXIA	*event duration*	?	?	?	?	V	?	?	●	●	?	?	?	?	●	●	●	?	?	●
	frequency of occurrence	?	?	?	?	V	?	?	●	●	?	?	?	?	●	●	●	?	●	●
	spatial coverage	?	?	?	?	V	?	?	●	●	?	?	?	?	●	●	●	?	●	●
HYPOXIA	*event duration*	?	?	?	V	V	?	?	●	●	?	?	?	?	●	●	●	?	?	●
	frequency of occurrence	?	?	?	V	V	?	?	●	●	?	?	?	?	●	●	●	?	●	●
	spatial coverage	?	?	?	V	V	?	?	●	●	?	?	?	?	●	●	●	?	●	●
BIOLOGICAL STRESS	*event duration*	?	?	?	V	V	?	?	●	●	?	?	?	?	●	●	●	?	?	●
	frequency of occurrence	?	?	?	?	V	?	?	●	●	?	?	?	?	●	●	●	?	●	●
	spatial coverage	?	?	?	V	V	?	?	●	●	?	?	?	?	●	●	●	?	●	●
PRIMARY PRODUCTIVITY		●•	●•		?	?	?	?	●	●	?	?	?	?	●	●	●	?	●	●
PLANKTONIC COMMUNITY		●•	●•		?	●	?	?	?	●	?	?	?	?	●	●	●	?	●	●
BENTHIC COMMUNITY		●•	●•		●	●	?	?	●	●	?	?	?	?	●	●	①	●	②	●
SAV (spatial coverage)		●•	●•		●	V	?	?	Λ	Λ	●	●	?	V	●	●	V	●	V	V

? - unknown   V - decreasing trend   • - speculative response   ● - no trend or shift   Λ - increasing trend   ① - shift from annelids to diverse   ② - shift from a mixture of annelids and and crustaceans to crustaceans

Source: NOAA 1996, 1997a-b

Table 21 (continued). Recent trends in selected parameters characterizing eutrophication, by estuary.

Parameter	Buzzards Bay (M S)	Narragansett Bay (T M S)	Gardiners Bay (M S)	Long Island Sound (T M S)	Connecticut River (T M)	Great South Bay (M S)	Hudson R./Raritan Bay (T M S)	Barnegat Bay (M S)	N. J. Inland Bays (M S)
CHLOROPHYLL A (µg/l)	? Λ•	● ● ●	● ●	● ● ●	? ?	● ●	? ● ●•	● ●	Λ• Λ•
TURBIDITY (concentration)	? ?	● ● ●	● ●	●• V V	? ?	● ●	? ? ?	? ?	? ?
NUISANCE ALGAE — *event duration*	? ?	Λ Λ Λ	● ?	? Λ Λ	? ?	? ?	? ●• ●•	● ●	● Λ•
frequency of occurrence	? ?	Λ Λ Λ	● ?	? Λ Λ	? ?	? ?	? ●• ●•	● ●	● Λ•
TOXIC ALGAE — *event duration*	? ?	? ? ?	? ?	● ● ●	? ?	● ●	? ●• ●•	● ●	● ●
frequency of occurrence	? ?	? ? ?	? ?	● ● ●	? ?	● ●	? ? ?	● ●	● ●
MACROALGAL ABUNDANCE	? ?	Λ Λ ?	Λ V	? Λ ●	? ?	● ●	? ? ?	? ?	? ?
EPIPHYTE ABUNDANCE	? ?	? ? ?	? ?	? Λ ●	? ?	● ●	? ? ?	? ?	? ?
NITROGEN (mg/l)	? Λ•	● ● ●	● V	● Λ• ●	● ?	● ●	V ● ●	? ?	? ?
PHOSPHORUS (mg/l)	? ?	● ● ●	● V	● Λ ●	● ?	● ●	● V V	? ?	? ?
BOTTOM DO (mg/l)	? ?	Λ Λ ●	● ●	Λ Λ V	? ?	● ●	? Λ V	? ?	? ?
ANOXIA — *event duration*	? ?	V V ●	● ●	● ● Λ	? ?	● ●	? V ●	? ?	? ?
frequency of occurrence	? ?	V• V• ?	? ?	? ? Λ	? ?	? ?	? V ?	? ?	? ?
spatial coverage	? ?	V V ●	● ●	● ● Λ	? ?	● ●	? V ●	? ?	? ?
HYPOXIA — *event duration*	? ?	V V ●	● ●	● ● Λ	V ?	● ●	? V Λ	? ?	? ?
frequency of occurrence	? ?	V• V• V•	? ?	? ? Λ	? ?	? ?	? V ?	? ?	? ?
spatial coverage	? ?	V V ●	● ●	● ● Λ	V ?	● ●	? V ●	? ?	? ?
BIOLOGICAL STRESS — *event duration*	? ?	V V ●	● ●	● ● Λ	? ?	● ●	? V ●	? ?	? ?
frequency of occurrence	? ?	V• V• V•	? ?	? ? Λ	? ?	? ?	? ? ?	? ?	? ?
spatial coverage	? ?	V V ●	● ●	● ● Λ	? ?	● ●	? V ●	? ?	? ?
PRIMARY PRODUCTIVITY	? ③	? ? ?	● ●	? ●• ●	? ?	● ●	? ③ ③	? ?	? ●•
PLANKTONIC COMMUNITY	? ?	④ ● ④	● ●	? ● ●	? ?	● ●	? ● ●	●• ●•	? ●•
BENTHIC COMMUNITY	? ?	① ● ●	? ?	● ● ●	? ?	● ●	⑤ ● ①	●• ●•	? ?
SAV (spatial coverage)	V V	● ● ●	Λ Λ	V V V	? ?	V V	? V V	? ?	? ?

Parameter	Delaware Bay (T M S)	DE Inland Bays (M S)	MD Inland Bays (M S)	Chincoteague Bay (S)	Chesapeake Bay (T M S)	Patuxent River (T M)	Potomac River (T M)	Rappahannock River (T M)	York River (T M)	James River (T M)	Chester River (T M)	Choptank River (T M)	Tan.Poc. Sounds (T M)
CHLOROPHYLL A (µg/l)	● ● ●	● ●	V• ●	?	● ● ●	Λ ●	● V	Λ Λ	Λ Λ	Λ Λ	● ●	● ●	Λ Λ
TURBIDITY (concentration)	● ● ●	● ●	● ?	●	● ● ●	● ●	● V	● ●	● ●	● ●	● ●	● V	● V
NUISANCE ALGAE — *event duration*	● ● ●	● ●	● ●	?	● ● ●	● ?	V ●	● ●	● ●	● ●	? ?	● ●	? ●
frequency of occurrence	● ● ●	● ●	● ●	?	● ● ●	● ●	V V	● ●	● ●	● ●	? ?	● ●	? ●
TOXIC ALGAE — *event duration*	● ● ●	? ?	? ?	?	● ● ●	? ?	● ●	● ●	● ●	● ●	? ?	● ●	? ●
frequency of occurrence	● ● ●	? ?	? ?	?	● ● ●	? ?	● ●	● ●	● ●	● ●	? ?	● ●	? ●
MACROALGAL ABUNDANCE	● ● ●	? ?	? ?	?	● ● ●	● ●	V ●	● ●	● ●	● ●	? ?	● ●	? Λ
EPIPHYTE ABUNDANCE	● ● ●	● ●	? ?	?	● ? ●	? ?	? ?	● ●	● ●	● ●	? ?	● V	? Λ
NITROGEN (mg/l)	V V V	● ●	V• ?	V•	● Λ• ●	V V	● ●	● ●	● ●	● ●	● ●	● ●	? V
PHOSPHORUS (mg/l)	Λ Λ Λ	● ●	V ●	V•	● V• ●	V V	V ●	Λ ●	Λ ●	● ●	● ●	● V	? V
BOTTOM DO (mg/l)	Λ Λ ●	● ●	● ●	●	● ● ●	Λ ●	Λ ●	● V	● ●	● V	● ●	● ●	● ●
ANOXIA — *event duration*	V V ●	? ?	● ?	?	● ● ●	● ●	● ●	? ?	● ●	● ?	● ●	● ●	● ●
frequency of occurrence	? ? ?	? ?	? ?	?	● ● ?	● ●	● ●	? ?	? ?	? ?	● ●	● Λ	● ●
spatial coverage	● V ●	? ?	● ●	?	● Λ ●	● ●	? ●	? ?	● ●	● ?	● ●	● ●	● ●
HYPOXIA — *event duration*	V V ●	● ●	● ?	?	● ● ●	● ●	● ●	? ?	● ●	● ?	● ●	● ●	● ●
frequency of occurrence	? ? ?	? ?	? ?	?	● ● ?	● ●	● ●	? ?	? ?	? ?	● ●	● Λ	● ●
spatial coverage	● V ●	● ●	● ●	?	● Λ ●	● ●	Λ ●	? ?	● ●	● ?	● ●	● ●	● ●
BIOLOGICAL STRESS — *event duration*	V V ●	● ●	● ●	?	● ● ●	V ●	● ●	● ?	● ●	● ?	● ●	● ●	● ●
frequency of occurrence	? ? ?	? ?	? ?	?	● ● ?	? ●	● V	? ?	? ?	? ?	● ●	● Λ	● ●
spatial coverage	V V ●	● ●	● ●	?	● Λ ●	V ●	V ●	● ?	● ●	● ?	● ●	● ●	● ●
PRIMARY PRODUCTIVITY	● ● ●	● ●	? ?	?	● ● ?	? ?	? ?	? ?	? ?	? ?	? ?	? ?	? ?
PLANKTONIC COMMUNITY	● ④ ④	① ●	● ●	?	● ● ●	● ●	● ●	● ●	● ●	● ●	? ●	● ●	? ?
BENTHIC COMMUNITY	? ? ②	● ●	● ●	?	● ● ●	● ●	● ●	● ●	● ●	● ●	● ●	● ●	? ?
SAV (spatial coverage)	● ● ●	● ●	● ?	Λ	● Λ Λ	Λ ●	Λ Λ	● Λ	● ●	● Λ	● Λ	● Λ	? Λ

? - unknown   V - decreasing trend   • - speculative response   Λ - increasing trend   ① - shift to diverse mixture   ② - shift to annelids and crustaceans   ③ - shift to pelagic   ④ - shift to diatoms   ⑤ - shift to mollusks

Source: NOAA 1996, 1997a-b

Table 21 (continued). Recent trends in selected parameters characterizing eutrophication, by estuary.

Parameter	Albemarle/Pamlico Sounds T	Albemarle/Pamlico Sounds M	Albemarle/Pamlico Sounds S	Pamlico River M	Neuse River T	Neuse River M	Bogue Sound M	Bogue Sound S	New River M	New River S	Cape Fear River T	Cape Fear River M	Cape Fear River S	Winyah Bay T	Winyah Bay M	Winyah Bay S
CHLOROPHYLL A (µg/l)	?	?	●•	Λ	●	Λ	?	●	?	?	?	?	●	?	?	●
TURBIDITY (concentrations)	V	?	?	?	●	?	?	●	?	?	Λ	?	?	Λ	Λ	●
NUISANCE ALGAE – event duration	?	●	?	?	V	Λ	●	●	?	?	?	?	?	●•	●•	●•
NUISANCE ALGAE – frequency of occurrence	?	●	?	?	V	Λ	●	●	?	?	?	?	?	●•	●•	●•
TOXIC ALGAE – event duration	?	●	?	?	V	Λ	●	?	?	?	?	?	?	●•	●•	●•
TOXIC ALGAE – frequency of occurrence	?	●	?	?	V	Λ	●	●	?	?	?	?	?	●•	●•	●•
MACROALGAL ABUNDANCE	V	?	?	?	?	●	?	●	?	?	●	●	●	?	?	?
EPIPHYTE ABUNDANCE	?	?	?	?	?	●	?	?	?	?	●	●	●	?	?	?
NITROGEN (mg/l)	?	●	?	●	Λ	Λ	●	●	?	?	?	?	?	V	V	V
PHOSPHORUS (mg/l)	?	●	?	V	●	●	●	●	?	?	?	?	?	V	V	V
BOTTOM DO (mg/l)	?	?	?	V	V	V	●•	●	?	?	?	?	?	?	?	?
ANOXIA – event duration	?	?	?	●	?	Λ	●	●	?	?	?	?	?	?	?	?
ANOXIA – frequency of occurrence	?	?	?	●	?	Λ	●	●	?	?	?	?	?	?	?	?
ANOXIA – spatial coverage	?	?	?	●	Λ	Λ	●	●	?	?	?	?	?	?	?	?
HYPOXIA – event duration	?	?	?	●	Λ	Λ	●	●	?	?	?	?	?	?	?	?
HYPOXIA – frequency of occurrence	?	?	?	●	Λ	Λ	●	●	?	?	?	?	?	?	?	?
HYPOXIA – spatial coverage	?	?	?	●	Λ	Λ	●	●	?	?	?	?	?	?	?	?
BIOLOGICAL STRESS – event duration	?	?	?	●	Λ	Λ	●	●	?	?	?	?	?	?	?	?
BIOLOGICAL STRESS – frequency of occurrence	?	?	?	●	Λ	Λ	●	●	?	?	?	?	?	?	?	?
BIOLOGICAL STRESS – spatial coverage	?	?	?	●	Λ	Λ	●	●	?	?	?	?	?	?	?	?
PRIMARY PRODUCTIVITY	●	?	?	●	●•	●	?	?	?	?	?	?	?	?	?	●
PLANKTONIC COMMUNITY	●	?	?	●	①	●	●	●	?	?	?	?	?	?	?	●
BENTHIC COMMUNITY	?	?	?	?	?	?	?	●•	?	?	?	?	?	?	?	●
SAV (spatial coverage)	V	V	?	V	●	V	?	?	?	?	?	?	?	?	?	●
WETLANDS (spatial coverage)	●	●	?	●	●	●	●	●	?	?	?	?	?	?	●	●

Parameter	N & S Santee River T	N & S Santee River M	Charleston Harbor T	Charleston Harbor M	Charleston Harbor S	Stono/N. Edisto River M	Stono/N. Edisto River S	St. Helena Sound M	St. Helena Sound S	Broad River M	Broad River S	Savannah River T	Savannah River M	Savannah River S	Ossabaw Sound T	Ossabaw Sound M	Ossabaw Sound S
CHLOROPHYLL A (µg/l)	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	●•	?
TURBIDITY (concentrations)	V	V	?	Λ	Λ	Λ	Λ	●	?	Λ	●	Λ	●	?	?	?	?
NUISANCE ALGAE – event duration	●•	●•	?	●	●•	?	?	?	?	?	?	?	●	●	?	●	●
NUISANCE ALGAE – frequency of occurrence	●•	●•	?	●	●•	?	?	?	?	?	?	?	●	●	?	●	●
TOXIC ALGAE – event duration	●•	●•	?	●	●•	?	?	?	?	?	?	?	●	●	?	●	●
TOXIC ALGAE – frequency of occurrence	●•	●•	?	●	●•	?	?	?	?	?	?	?	●	●	?	●	●
MACROALGAL ABUNDANCE	●•	●•	Λ	?	?	●	●	?	?	?	?	?	●	●	?	?	?
EPIPHYTE ABUNDANCE	●•	●•	?	?	?	●	●	?	?	?	?	?	●	●	?	?	?
NITROGEN (mg/l)	V	V	V	V	V	V	?	V	?	●	?	●	●	●	●	●	?
PHOSPHORUS (mg/l)	V	V	V	V	V	V	V	●	?	●	●	●	●	●	●	●	?
BOTTOM DO (mg/l)	?	?	?	?	?	?	?	?	?	?	?	?	Λ	?	?	?	?
ANOXIA – event duration	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
ANOXIA – frequency of occurrence	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
ANOXIA – spatial coverage	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
HYPOXIA – event duration	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
HYPOXIA – frequency of occurrence	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
HYPOXIA – spatial coverage	?	?	?	?	?	?	?	?	?	?	?	?	Λ	?	?	?	?
BIOLOGICAL STRESS – event duration	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
BIOLOGICAL STRESS – frequency of occurrence	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
BIOLOGICAL STRESS – spatial coverage	?	?	?	?	?	?	?	?	?	?	?	?	Λ	?	?	?	?
PRIMARY PRODUCTIVITY	?	?	?	?	?	?	?	●	?	?	?	?	?	?	?	?	?
PLANKTONIC COMMUNITY	?	?	●	?	?	?	?	?	?	?	?	?	?	?	?	?	?
BENTHIC COMMUNITY	?	?	?	●	●	●	●	?	?	?	?	?	●	?	?	?	?
SAV (spatial coverage)	?	?	?	Λ	?	●	●	?	?	?	?	?	●	●	?	?	?
WETLANDS (spatial coverage)	●	●	?	●	●	●	●	●	●	●	●	?	V•	V•	?	?	?

Parameter	St. Catherine/Sapelo Sound M	St. Catherine/Sapelo Sound S	Altamaha River T	Altamaha River M	Altamaha River S	St. Andrews/St. Simon Sound T	St. Andrews/St. Simon Sound M	St. Andrews/St. Simon Sound S	St. Marys/Cumberland Sound M	St. Marys/Cumberland Sound S	St. Johns River T	St. Johns River M	St. Johns River S	Indian River S	Biscayne Bay M	Biscayne Bay S
CHLOROPHYLL A (µg/l)	?	?	?	?	?	?	?	?	?	?	●	●	●	Λ•	●	●
TURBIDITY (concentrations)	?	?	?	●	?	?	?	?	?	?	●	●	●	●	●	V
NUISANCE ALGAE – event duration	●	●	?	●	?	?	●	●	●	●	●	●	●	●	●•	●•
NUISANCE ALGAE – frequency of occurrence	●	●	?	●	●	?	●	●	●	●	●	●	●	●	●•	●•
TOXIC ALGAE – event duration	●	●	?	●	●	?	●	●	●	●	●	●	●	●	●•	●•
TOXIC ALGAE – frequency of occurrence	●	●	?	●	●	?	●	●	●	●	●	●	●	●	●•	●•
MACROALGAL ABUNDANCE	●	●	?	●	●	●	●	●	●	●	●	●	●	●	●	●
EPIPHYTE ABUNDANCE	●	●	?	●	●	●	●	●	●	●	●	●	●	?	●	●
NITROGEN (mg/l)	Λ•	?	V	V	?	Λ•	Λ•	?	●	?	●	●	●	●•	V	Λ
PHOSPHORUS (mg/l)	Λ•	?	●	●	?	Λ•	Λ•	?	●	?	●	●	●	●•	●	V
BOTTOM DO (mg/l)	?	?	?	?	?	?	?	?	?	?	●	●	●	●	V	V
ANOXIA – event duration	?	?	?	?	?	?	?	?	?	?	●	●	●	●	●	●
ANOXIA – frequency of occurrence	?	?	?	?	?	?	?	?	?	?	●	●	●	●	●	●
ANOXIA – spatial coverage	?	?	?	?	?	?	?	?	?	?	●	●	●	●	●	●
HYPOXIA – event duration	?	?	?	?	?	?	?	?	?	?	●	●	●	●	●	●
HYPOXIA – frequency of occurrence	?	?	?	?	?	?	?	?	?	?	●	●	●	●	●	●
HYPOXIA – spatial coverage	?	?	?	?	?	?	?	?	?	?	●	●	●	●	●	●
BIOLOGICAL STRESS – event duration	●•	?	●•	●•	?	●•	●•	?	●•	?	●	●	●	●	●	●
BIOLOGICAL STRESS – frequency of occurrence	●•	?	●	●	?	●•	●•	?	●•	?	●	●	●	●	●	●
BIOLOGICAL STRESS – spatial coverage	●•	?	●•	●•	?	●•	●•	?	●•	?	●	●	●	●	●	●
PRIMARY PRODUCTIVITY	?	?	?	?	?	?	?	?	?	?	?	?	?	●•	?	●
PLANKTONIC COMMUNITY	?	?	?	?	?	?	?	?	?	?	●	●	●	?	?	●
BENTHIC COMMUNITY	?	?	?	?	?	?	?	?	?	?	●	●	●	②	?	●
SAV (spatial coverage)	●	●	?	●	●	?	●	●	●	●	V	V	●	V•	●	Λ
WETLANDS (spatial coverage)	?	?	?	?	?	?	?	?	?	?	?	?	?	V•	V	V

? - unknown V - decreasing trend • - speculative response ● - no trend or shift Λ - increasing trend ① - shift from annelids to diverse mixture ② - shift from a mixture of annelids and crustaceans to crustaceans

Source: NOAA 1996, 1997a-b

Table 22. **Importance of wetlands to bluefish as habitat.**

Species Name:	*Pomatomus saltatrix*	Bluefish
Relationship to salt marsh habitat	Juvenile bluefish (*Pomatomus saltatrix*) utilize salt marsh creeks as foraging and nursery habitat (Roundtree, 1992). The bluefish is common in shallow tidal embayments and estuaries of southern New England during summer and early fall (Bigelow and Schroeder, 1953; Friendland et al., 1988; Oliver et al., 1989). While *P. saltatrix* are less common north of Cape Cod, their abundance have increased dramatically in the Gulf of Maine since the 1970s (Bigelow and Schroeder, 1953; Creaser and Perkins, 1994).	
Habitat requirements	Bluefish exhibit a strong preference for subtidal marsh creeks and make ony limited use of intertidal habitat for foraging (Roundtree, 1992).	
Food web relationship	Quantitative data about this species' rate of biomass production are lacking.	
Food habitats	Several marsh-dependent species of fish are important components of the bluefish's diet. The Atlantic silverside is one of the dominant food items in the diet of the bluefish (Friendland et al., 1988). Creaser and Perkins (1994) and Friendland et al. (1988) report sand shrimp (*Crangon septemspinosa*) made up 23% and 32% respectively the diet of juvenile bluefish.	
Value*	Bluefish are one of the most important recreational species of fish found along the east coast of the United States. In 1993, almost seven million pounds of bluefish, valued at $1.8 million, were landed in the northeastern United States.	

Source: Minton 1997.

Table 23. Commercial and recreational landings of bluefish (000's lbs) along the Atlantic Coast of the United States, 1981-1996.

YEAR	REC	COM	TOTAL	%REC	%COMM
1981	95,288	16,454	111,742	85	15
1982	83,006	15,430	98,436	84	16
1983	89,122	15,799	104,921	85	15
1984	67,453	11,863	79,316	85	15
1985	52,515	13,501	66,016	80	20
1986	92,887	14,677	107,564	86	14
1987	76,653	14,504	91,157	84	16
1988	48,222	15,790	64,012	75	25
1989	39,260	10,341	49,601	79	21
1990	30,557	13,771	44,328	69	31
1991	32,997	13,581	46,578	71	29
1992	24,275	11,478	35,753	68	32
1993	20,292	10,122	30,414	67	33
1994	15,541	9,453	24,994	62	38
1995	14,174	7,847	22,021	64	36
1996	14,735	9,288	24,023	61	39
AVG 81-89	71,601	14,262	85,875	83	17
AVG 81-96	49,811	12,744	62,555	80	20

Source: Unpublished NMFS General Canvass and MRFSS data.

Table 24. Bluefish commercial landings by gear, Maine to Florida, 1987-1996 combined.

Gear	1000 lbs	Percent
Haul Seines, Beach	1,639	1
Haul Seines, Long	2,328	2
Unk. Combined Gears	12,295	10
Purse Seines, Menhaden	47	*
Purse Seines, Other	801	0
Otter Trawl Bottom, Crab	3	*
Otter Trawl Bottom, Fish	22,429	19
Otter Trawl Bottom, Lobster	6	*
Otter Trawl Bottom, Scallop	2	*
Otter Trawl Bottom, Shrimp	274	*
Otter Trawl Bottom, Other	4	*
Trawl Midwater, Paired	153	*
Trawl Bottom, Paired	16	*
Pound Nets, Fish	8,654	7
Pound Nets, Other	375	*
Floating Traps (Shallow)	1,238	1
Fyke And Hoop Nets, Fish	17	*
Pots And Traps, Crab, Blue	8	*
Pots And Traps, Fish	67	*
Pots And Traps, Lobster Inshore	2	*
Gill Nets, Set, Salmon	44	*
Gill Nets, Other	28,512	24
Gill Nets, Sink, Other	15,293	13
Gill Nets, Drift, Other	6,755	5
Gill Nets, Drift, Runaround	7,373	6
Gill Nets, Stake	65	*
Trammel Nets	7	*
Lines Hand, Other	6,626	5
Lines Jigging Machine	41	*
Lines Troll, Tuna	0	*
Lines Troll, Other	918	0
Lines Long Set With Hooks	168	*
Dredges Scallop, Sea	5	*
ALL GEAR	116,181	100

Source: Unpublished NMFS General Canvass data.

Table 25. Bluefish commercial landings by state and gear type, 1987-1996 combined.

	STATE													
	ME	NH	MA	RI	CT	NY	NJ	DE	MD	VA	NC	SC	GA	FL
	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL
GEAR														
Haul Seines, Beach	.	.	.	.	.	0.6	.	.	0.1	2.8	3.7	.	.	.
Haul Seines, Long	.	.	.	.	.	.	.	.	.	.	6.6	20.6	.	.
Unk. Combined Gears	.	0.1	5.6	0.0	21.4	0.0	0.1	0.0	3.5	11.7	0.0	19.8	55.0	100.0
Purse Seines, Menhaden	.	.	.	.	.	.	0.2	.	.	0.1	.	.	.	.
Purse Seines, Other	.	.	.	.	.	.	4.0	.	.	.	.	.	.	.
Otter Trawl Bottom, Crab	.	.	.	.	.	.	.	.	.	.	0.0	.	.	.
Otter Trawl Bottom, Fish	3.0	1.4	5.9	70.1	40.1	34.2	14.5	.	8.3	11.4	12.9	0.1	.	.
Otter Trawl Bottom, Lobster	.	.	.	.	.	0.0	0.0	.	.	.	.	.	.	.
Otter Trawl Bottom, Scallop	.	.	.	.	.	.	0.0	.	0.0	0.0	0.0	.	.	.
Otter Trawl Bottom, Shrimp	.	.	.	0.0	.	.	.	.	.	0.0	0.8	.	0.3	.
Otter Trawl Bottom, Other	.	.	.	.	.	.	.	.	0.1	0.0	.	.	.	.
Trawl Midwater, Paired	.	.	1.7	.	.	0.0	.	.	.	.	.	.	.	.
Trawl Bottom, Paired	.	.	.	0.0	.	0.1	.	.	.	.	.	.	.	.
Pound Nets, Fish	.	.	0.7	0.0	0.1	13.2	13.3	.	19.1	35.2	1.3	.	.	.
Pound Nets, Other	.	.	1.7	.	.	1.6	.	.	.	.	.	.	.	.
Floating Traps (Shallow)	6.0	.	0.1	10.7	.	.	.	.	.	.	.	.	.	.
Fyke And Hoop Nets, Fish	.	.	.	.	0.2	0.0	.	0.0	0.5	0.0	.	.	.	.
Pots And Traps, Crab, Blue	.	.	.	.	.	.	0.0	.	.	0.0	0.0	.	.	.
Pots And Traps, Fish	.	.	0.6	0.0	.	0.0	0.0	.	0.2	0.0	0.0	0.1	.	.
Pots And Traps, Lobster Inshore	.	0.0	.	0.0	.	0.0	0.0	.	.	.	.	.	.	.
Gill Nets, Set, Salmon	.	.	.	.	.	0.3	.	.	.	.	.	.	.	.
Gill Nets, Other	19.0	9.2	5.2	3.3	.	6.4	0.9	31.2	5.6	4.8	72.2	4.4	.	.
Gill Nets, Sink, Other	71.8	88.5	38.9	13.4	0.0	29.3	14.5	2.7	10.2	13.8	.	.	.	.
Gill Nets, Drift, Other	.	.	0.2	.	2.9	0.0	17.5	62.3	19.2	19.1	0.1	.	.	.
Gill Nets, Drift, Runaround	.	.	5.1	.	.	0.0	32.7	.	.	.	1.1	.	.	.
Gill Nets, Stake	.	.	.	.	0.1	.	.	.	1.3	0.3	.	.	.	.
Trammel Nets	.	.	.	.	.	.	0.0	.	.	.	.	.	.	.
Lines Hand, Other	0.0	0.8	28.1	0.7	35.2	14.2	2.0	3.7	32.0	0.7	0.1	54.6	44.7	.
Lines Jigging Machine	.	.	0.5	.	.	.	.	.	.	.	.	.	.	.
Lines Troll, Tuna	.	.	.	0.0	.	.	0.0	.	0.0	.	.	.	.	.
Lines Troll, Other	.	.	4.1	1.6	.	.	0.0	.	.	.	1.0	0.3	.	.
Lines Long Set With Hooks	0.1	0.0	1.5	0.0	.	0.0	0.1	.	0.0	0.0	0.0	0.0	.	.
Dredges Scallop, Sea	.	.	0.0	0.0	.	.	0.0	.	.	0.0	.	.	.	.
ALL GEAR	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Unpublished NMFS General Canvass data.

Table 26. Bluefish commercial landings by year and gear type, Maine to Florida.

	85	86	87	88	89	90	91	92	93	94	95	96
	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL	% OF TOTAL
GEAR												
Haul Seines, Beach	5.1	0.7	1.0	1.4	0.6	2.7	2.4	1.4	0.3	1.0	0.9	1.7
Haul Seines, Long	3.5	3.2	3.3	2.3	2.9	2.2	2.1	2.5	1.1	0.9	0.9	0.5
Unk. Combined Gears	4.8	8.0	10.8	8.3	9.7	7.8	10.9	9.5	13.5	22.5	13.5	2.1
Purse Seines, Menhaden	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	.	.
Purse Seines, Tuna	0.5	0.7	.	.	.	.	.	.	.	.	.	.
Purse Seines, Other	0.5	4.1	.	0.8	.	.	2.6	0.5	2.2	.	0.4	.
Otter Trawl Bottom, Crab	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.	0.0	0.0
Otter Trawl Bottom, Fish	25.5	22.0	15.8	16.6	22.4	16.6	18.9	27.5	18.5	19.1	21.0	19.9
Otter Trawl Bottom, Lobster	0.0	.	0.0	.	.	.	0.0	.	.	.	.	.
Otter Trawl Bottom, Scallop	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Otter Trawl Bottom, Shrimp	1.0	0.7	0.5	0.4	0.3	0.4	0.3	0.1	0.1	0.0	0.0	0.0
Otter Trawl Bottom, Other	.	.	.	.	.	.	.	.	.	.	0.0	0.0
Trawl Midwater, Paired	1.0	0.0	0.1	0.1	0.2	0.3	0.3	0.2	0.1	.	.	.
Trawl Bottom, Paired	0.0	0.1	0.1	.	.	.	0.0	0.0	.	.	.	.
Pound Nets, Fish	12.4	10.7	9.5	18.9	2.6	6.7	5.4	4.6	5.8	4.6	4.4	5.1
Pound Nets, Other	.	.	.	.	0.2	0.2	0.0	0.0	2.3	0.3	0.6	0.1
Floating Traps (Shallow)	0.9	1.0	0.8	0.5	1.1	1.4	0.8	2.6	1.1	0.3	1.7	0.6
Fyke And Hoop Nets, Fish	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	.	0.0
Pots And Traps, Crab, Blue	0.0	0.0	0.0	0.0	.	0.0	.	0.0	.	0.0	0.0	0.0
Pots And Traps, Fish	.	0.0	0.1	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0
Pots And Traps, Lobster Inshore	.	.	0.0	.	0.0	.	.	.	0.0	0.0	0.0	0.0
Gill Nets, Set, Salmon	.	.	.	.	.	.	.	.	.	.	0.6	.
Gill Nets, Sea Bass	0.0	.	.	.	.	.	.	.	.	.	.	.
Gill Nets, Other	24.6	26.6	35.1	27.2	20.7	25.2	21.3	14.0	21.0	16.0	31.9	30.8
Gill Nets, Sink, Other	.	.	.	.	17.4	16.0	13.8	21.9	17.7	24.5	16.6	16.2
Gill Nets, Drift, Other	5.1	4.5	4.0	5.9	4.1	4.3	9.8	4.3	3.0	6.5	3.0	13.6
Gill Nets, Drift, Runaround	6.0	10.9	11.0	10.5	11.4	9.0	4.8	3.7	5.9	0.0	0.1	0.1
Gill Nets, Stake	.	0.1	0.1	0.2	.	0.0	0.2	.	.	.	.	0.1
Trammel Nets	.	.	.	.	.	.	0.1	.	.	.	.	.
Lines Hand, Other	6.8	5.7	6.4	6.0	4.6	5.9	5.1	5.7	6.4	3.6	3.7	8.9
Lines Jigging Machine	.	.	.	.	.	0.3	.	.	.	.	.	.
Lines Troll, Tuna	0.0	0.0	0.0	0.0	.	.	0.0	.	.	.	.	.
Lines Troll, Other	0.6	0.8	1.4	0.7	1.7	0.8	1.0	0.6	0.7	0.1	0.3	0.1
Lines Long Set With Hooks	1.6	0.2	0.0	0.1	0.0	0.1	0.1	0.2	0.3	0.4	0.5	0.1
Dredges Scallop, Sea	.	0.0	.	.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ALL GEAR	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Unpublished NMFS General Canvass data.

Table 27. **Bluefish commercial landings by year and area, Maine to Florida.**

	STATE <3 MI		EEZ >3MI		TOTAL	
	1000 LBS	% OF TOTAL	1000 LBS	% OF TOTAL	1000 LBS	% OF TOTAL
YEAR						
85	9,523	70	3,976	29	13,500	100
86	10,375	70	4,300	29	14,676	100
87	10,470	72	4,032	27	14,503	100
88	10,547	66	5,241	33	15,789	100
89	6,076	58	4,265	41	10,341	100
90	8,091	58	5,679	41	13,771	100
91	8,164	60	5,417	39	13,581	100
92	5,468	52	4,919	47	10,388	100
93	4,932	55	3,992	44	8,925	100
94	3,650	61	2,291	38	5,942	100
Average	7,730	63	4,411	36.	12,141	100

Source: Unpublished NMFS General Canvass data.
Note: Does not include landings from unknown water areas.
Due to a change in the reporting system, commercial landings by area are not available for 1995 and 1996.

Table 28. Bluefish commercial landings by region, area and year.

REGION	AREA		85	86	87	88	89	90	91	92	93	94
NEW ENGLAND	ST (<3 MI)	1000 LBS	1,239	1,341	1,021	998	1,175	1,176	1,083	1,076	688	713
		% REG	44	43	42	50	41	41	39	36	31	70
		% CST	13	12	9	9	19	14	13	19	13	19
	EEZ (>3 MI)	1000 LBS	1,546	1,718	1,369	965	1,678	1,642	1,673	1,886	1,493	293
		% REG	55	56	57	49	58	58	60	63	68	29
		% CST	38	39	33	18	39	28	30	38	37	12
	ALL	1000 LBS	2,786	3,060	2,391	1,963	2,854	2,819	2,756	2,963	2,182	1,006
		% REG	100	100	100	100	100	100	100	100	100	100
		% CST	20	20	16	12	27	20	20	28	24	16
MID-ATLANTIC	ST (<3 MI)	1000 LBS	4,556	4,884	4,563	5,915	1,853	2,965	2,997	2,643	2,742	2,175
		% REG	70	69	76	79	58	55	55	57	67	69
		% CST	47	47	43	56	30	36	36	48	55	59
	EEZ (>3 MI)	1000 LBS	1,915	2,106	1,433	1,549	1,340	2,330	2,423	1,940	1,294	969
		% REG	29	30	23	20	41	44	44	42	32	30
		% CST	48	48	35	29	31	41	44	39	32	42
	ALL	1000 LBS	6,472	6,990	5,997	7,465	3,193	5,295	5,421	4,583	4,036	3,145
		% REG	100	100	100	100	100	100	100	100	100	100
		% CST	47	47	41	47	30	38	39	44	45	52
SOUTH ATLANTIC	ST (<3 MI)	1000 LBS	3,727	4,150	4,885	3,634	3,047	3,949	4,083	1,748	1,501	761
		% REG	87	89	79	57	70	69	75	61	55	42
		% CST	39	39	46	34	50	48	50	31	30	20
	EEZ (>3 MI)	1000 LBS	514	475	1,229	2,727	1,245	1,706	1,319	1,093	1,204	1,028
		% REG	12	10	20	42	29	30	24	38	44	57
		% CST	12	11	30	52	29	30	24	22	30	44
	ALL	1000 LBS	4,242	4,626	6,114	6,361	4,292	5,656	5,403	2,841	2,706	1,789
		% REG	100	100	100	100	100	100	100	100	100	100
		% CST	31	31	42	40	41	41	39	27	30	30
ALL	ST (<3 MI)	1000 LBS	9,523	10,375	10,470	10,547	6,076	8,091	8,164	5,468	4,932	3,650
		% REG	70	70	72	66	58	58	60	52	55	61
		% CST	100	100	100	100	100	100	100	100	100	100
	EEZ (>3 MI)	1000 LBS	3,976	4,300	4,032	5,241	4,265	5,679	5,417	4,919	3,992	2,291
		% REG	29	29	27	33	41	41	39	47	44	38
		% CST	100	100	100	100	100	100	100	100	100	100
	ALL	1000 LBS	13,500	14,676	14,503	15,789	10,341	13,771	13,581	10,388	8,925	5,942
		% REG	100	100	100	100	100	100	100	100	100	100
		% CST	100	100	100	100	100	100	100	100	100	100

Source: Unpublished NMFS General Canvass data.
Note: Does not include landings from unknown areas.

Table 29. Commercial landings of bluefish by year and state.

	YEAR											
	85	86	87	88	89	90	91	92	93	94	95	96
	1000 LBS	1000 LBS	1000 LBS	1000 LBS	1000 LBS	1000 LBS	1000 LBS	1000 LBS	1000 LBS	1000 LBS	1000 LBS	1000 LBS
STATE												
ME	90	103	105	8	76	53	124	86	18	53	19	12
NH	22	61	128	23	137	197	127	228	162	275	187	159
MA	798	1,562	797	806	1,240	1,204	756	829	636	1,197	539	906
RI	1,692	1,142	1,184	1,023	1,206	1,184	1,490	1,550	1,195	901	772	642
CT	181	190	175	102	193	179	257	268	170	152	.	101
NY	2,133	1,617	1,564	1,125	564	1,612	1,578	1,492	1,549	1,472	1,304	1,590
NJ	1,988	3,003	2,532	2,483	1,579	2,170	2,447	2,198	2,191	1,892	847	1,611
DE	188	400	354	209	104	143	337	92	59	34	36	137
MD	509	456	363	1,031	272	285	233	206	133	162	106	82
VA	1,652	1,513	1,182	2,615	673	1,083	823	593	103	587	518	615
NC	3,604	3,450	4,561	5,039	3,291	4,578	3,919	2,839	2,705	1,782	3,010	3,298
SC	1	8	3	3	2	1	1	2	0	6	0	2
GA	0	2	2	2	0	0	0	0	0	0	1	0
FL	636	1,165	1,547	1,315	998	1,076	1,482	1,089	1,197	933	504	133

Source: Unpublished NMFS General Canvass data.

Table 30. Commercial landings of bluefish by state by month, 1987-1996 combined.

STATE	JAN 1000 LBS	FEB 1000 LBS	MAR 1000 LBS	APR 1000 LBS	MAY 1000 LBS	JUN 1000 LBS	JUL 1000 LBS	AUG 1000 LBS	SEP 1000 LBS	OCT 1000 LBS	NOV 1000 LBS	DEC 1000 LBS	ALL 1000 LBS
ME	0	.	.	*	0	6	18	20	8	2	0	0	55
NH	.	.	.	.	0	13	20	55	64	8	0	*	162
MA	0	0	.	.	11	51	122	125	202	84	10	0	608
RI	3	0	0	2	43	85	105	125	172	296	248	31	1,115
CT	.	0	.	0	0	0	1	1	1	2	0	.	10
NY	5	1	2	8	151	173	225	240	196	198	128	18	1,350
NJ	8	1	2	25	463	355	205	181	230	267	216	36	1,995
DE	.	.	.	0	4	3	1	1	0	1	0	33	47
MD	0	0	1	29	33	31	31	38	43	34	26	16	287
VA	21	3	8	91	106	98	83	97	100	91	81	41	826
NC	475	404	623	435	204	89	80	110	153	176	234	513	3,502
SC	0	0	0	0	0	0	0	0	0	0	0	*	2
GA	0	0	0	0	0	0	0	0	0	.	*	0	0
FL	178	207	190	194	33	6	6	6	18	66	36	82	1,027
ALL	695	619	828	787	1,055	916	902	1,005	1,193	1,231	984	773	10,993

Source: Unpublished NMFS General Canvass data.

Table 31. The number ('000) of bluefish caught and landed by recreational anglers by year.

	Catch	Landings	% Catch Released
1987	27,603	21,076	24
1988	13,365	9,905	26
1989	18,637	13,600	27
1990	16,446	11,365	31
1991	18,292	11,943	35
1992	11,400	7,158	37
1993	9,925	5,725	42
1994	11,970	5,768	52
1995	10,476	5,128	51
1996	9,899	4,570	54
Average	14,796	9,624	35

Source: Unpublished MRFSS data.

Table 32. Recreational landings ('000 lbs) of bluefish by year and region, Maine to Florida.

		Weight	
	NA	MA	SA
1987	20,930	48,407	7,316
1988	11,726	27,996	8,501
1989	11,332	23,184	4,744
1990	10,487	16,697	3,372
1991	12,199	17,672	3,127
1992	8,414	13,365	2,496
1993	9,209	8,735	2,348
1994	7,996	6,284	1,261
1995	5,992	6,973	1,209
1996	6,644	7,050	1,040
Average	10,493	17,636	3,541

Source: Unpublished MRFSS data.

Table 33. The percent of total weight of bluefish landed by marine recreational fishermen from state waters and the EEZ in each Atlantic coast subregion, Maine to Florida.

Subregion	Year	State	EEZ
North Atlantic			
	1987	71	29
	1988	64	36
	1989	69	31
	1990	86	14
	1991	78	22
	1992	77	23
	1993	72	28
	1994	86	14
	1995	82	18
	1996	54	46
	Average	74	26
Mid-Atlantic			
	1987	64	36
	1988	63	37
	1989	57	43
	1990	69	31
	1991	74	26
	1992	75	25
	1993	77	23
	1994	78	22
	1995	70	30
	1996	63	37
	Average	67	33
South Atlantic			
	1987	66	34
	1988	92	8
	1989	94	6
	1990	93	7
	1991	96	4
	1992	84	16
	1993	90	10
	1994	92	8
	1995	92	8
	1996	89	11
	Average	87	13

Source: Unpublished MRFSS data.

Table 34. The percentage (%) of bluefish caught and landed by recreational fishermen for each mode, Maine to Florida, 1987-1996.

Mode	Catch (Number)	Landing (Weight)
Shore	36	15
Party/Charter	13	26
Private/Rental	51	59

Source: Unpublished MRFSS data.

Table 35. The average annual recreational landings of bluefish by state, 1987-1996.

State	1,000 lbs	%
ME	627	1.98
NH	259	0.82
MA	3,632	11.47
RI	1,417	4.47
CT	4,558	14.39
NY	6,753	21.32
NJ	6,927	21.87
DE	357	1.13
MD	2,534	8.00
VA	1,065	3.36
NC	2,326	7.34
SC	130	0.41
GA	42	0.13
FL	1,044	3.29

Source: Unpublished MRFSS data.

Table 36. Exvessel value of bluefish commercial landings value by year and water area, Maine to Florida.

	STATE <3 MI		EEZ >3 MI		TOTAL	
	1000 $	%OF TOTAL	1000 $	%OF TOTAL	1000 $	%OF TOTAL
YEAR						
85	1,749	75	563	24	2,313	100
86	1,798	71	704	28	2,503	100
87	2,287	72	869	27	3,157	100
88	1,950	69	837	30	2,788	100
89	1,377	62	823	37	2,200	100
90	1,861	58	1,320	41	3,181	100
91	1,595	57	1,162	42	2,757	100
92	1,209	52	1,081	47	2,291	100
93	1,529	59	1,044	40	2,574	100
94	1,094	58	764	41	1,858	100
Average	1,645	64	917	35	2,562	100

Source: Unpublished NMFS General Canvass data.
Note: Does not include landings from unknown water areas.
Due to a change in the reporting system, commercial landings by area are not available for 1995 and 1996.

Table 37. Exvessel value of commercial bluefish landings by year, Maine-Florida.

	NOMINAL VALUE (1000 $)	NOMINAL PRICE (MEAN)	1996 ADJUSTED (MEAN)
YEAR			
85	2,313	0.17	0.14
86	2,503	0.17	0.13
87	3,157	0.22	0.17
88	2,788	0.18	0.15
89	2,214	0.21	0.19
90	3,181	0.23	0.21
91	2,757	0.20	0.19
92	2,608	0.23	0.21
93	3,080	0.30	0.29
94	2,795	0.30	0.28
95	2,844	0.36	0.35
96	2,799	0.30	0.30

Source: Unpublished NMFS General Canvass data.

Table 38. Average exvessel landings of bluefish, value and price by month, Maine to Florida, 1985-1994.

	WATER AREA								
	ST (<3 MI) 1996 Adjusted			EEZ (>3 MI) 1996 Adjusted			ALL 1996 Adjusted		
MONTH	1000 LBS	VALUE 1000 $	PRICE	1000 LBS	VALUE 1000 $	PRICE	1000 LBS	VALUE 1000 $	PRICE
January	279	53	0.19	343	65	0.19	622	119	0.19
February	276	53	0.19	299	55	0.19	575	108	0.19
March	373	73	0.20	410	73	0.18	784	147	0.19
April	616	117	0.19	185	41	0.22	801	158	0.20
May	856	164	0.19	218	45	0.21	1,075	209	0.19
June	600	132	0.22	394	94	0.24	995	226	0.23
July	552	123	0.22	432	95	0.22	985	218	0.22
August	699	149	0.21	400	94	0.24	1,100	243	0.22
September	800	141	0.18	463	73	0.16	1,264	215	0.17
October	841	131	0.16	523	72	0.14	1,364	203	0.15
November	534	66	0.13	474	62	0.13	1,008	129	0.13
December	547	63	0.12	251	35	0.14	798	98	0.12
ALL	6,977	1,270	0.18	4,398	809	0.18	11,376	2,079	0.18

Source: Unpublished NMFS General Canvass data.
Note: Does not include landings from unknown areas.
Due to a change in the reporting system, commercial landings by area are not available for 1995 and 1996.

Table 39. Average total cost[a] for a day trip, by mode for selected states (1980-1989).

State	Pier	Beach	Mode Party	Charter	Rental	Private
New York	$16.09	$13.77	$43.35	$59.88	$78.19	$44.38
New Jersey	21.10	16.32	45.36	146.66	92.41	40.93
Delaware	34.15	44.44	69.69	73.66	[b]	40.33
Maryland	21.71	23.31	57.27	181.08	52.25	41.19
Virginia	20.14	15.20	36.00	74.00	122.47	44.50
North Carolina	24.85	18.69	137.00	222.81	237.03	53.03

[a] Travel and services (services might be composed of a combination of the following: costs for bait, tackle, cleaning, fuel, pier fees, and boat fees).
[b] Not enough observations for precise estimates.

Source: Adapted from Strand *et al.* 1991.

Table 40. Charter and party boat survey distribution and returns, 1990.

State	Number sent	Usable returns	Non-usable returns
ME	24	5	1
NH	21	5	-
MA	80	17	9
RI	15	7	2
CT	17	4	2
NY	92	24	3
NJ	159	51	6
PA	16	7	1
DE	14	3	-
MD	4	2	-
VA	143	44	5
NC	1	1	-
FL	6	2	1
Total	592	172	30

Table 41. Relative Customer Interest and Success in Catching Selected Species in 1989. (1 = Low, 2 = Somewhat Low, 3 = Moderate, 4 = Somewhat High, and 5 = High).

	Charter boats		Party boats	
Species	Interest (mean)	Success (mean)	Interest (mean)	Success (mean)
Large pelagics (marlin, tunas)	3.9	2.4	3.1	2.8
Sharks (other than dogfish)	3.2	2.4	2.1	1.9
Bluefish	3.9	3.9	4.6	4.0
Atlantic mackerel	2.4	3.0	3.5	3.5
Summer flounder	3.2	1.9	3.6	1.5
Scup	1.4	1.7	2.2	2.0
Black sea bass	2.1	2.6	3.2	2.9
Hakes	1.4	1.6	2.3	2.5
Groundfish (cod, haddock, yellowtail)	3.0	2.6	3.0	2.4
Weakfish	3.1	1.7	3.3	1.7
Striped bass	3.7	2.5	3.5	1.7
Other: spot	4.6	3.9	4.7	3.4

Table 42. Party and Charter Boat Operating Experience in 1985 and 1989.

	Charter		Party	
	1985 (mean)	1989 (mean)	1985 (mean)	1989 (mean)
Ave. number of trips per year	57.0	50.0	142.0	130.0
Ave. number of trips per day OR	1.0	1.0	1.3	1.4
Ave. number of days per trip	1.1	1.1	1.2	1.3
Ave. number days fishing per week	3.2	3.1	5.0	4.6
Ave. number of anglers per trip	5.2	5.1	20.9	19.5
Ave. trip price per customer ($)	121.8	149.5	26.2	29.2
Ave. number of fish Taken per customer	10.9	8.3	15.2	9.9
Ave. number of crew members	1.4	1.4	2.1	2.0
Ave. cost of fuel & supplies ($)	96.1	131.1	113.3	146.6

Table 43. Mean recreational anglers' ratings of reasons for marine fishing, by subregion.

	New England			Mid-Atlantic		
Statement	Not Important	Somewhat Important	Very Important	Not Important	Somewhat Important	Very Important
To Spend Quality Time with Friends and Family	4.4%	14.3%	81.3%	3.0%	12.0%	85.0%
To Enjoy Nature and the Outdoors	1.4%	10.1%	88.5%	1.1%	11.6%	87.3%
To Catch Fish to Eat	42.2%	37.4%	20.4%	29.3%	40.1%	30.6%
To Experience the Excitement or Challenge of Sport Fishing	6.2%	24.9%	68.8%	8.4%	26.0%	65.6%
To Be Alone	55.0%	27.9%	17.1%	57.7%	25.8%	16.4%
To Relax and Escape from my Daily Routine	3.4%	13.3%	83.3%	2.6%	11.9%	85.5%
To Fish in a Tournament of when Citations are Available	78.6%	14.0%	7.4%	73.4%	17.1%	9.5%

Source: Steinback and O'Neil. MS.

Table 44. Mean recreational anglers' ratings of fishing regulation methods, by subregion.

	New England		Mid-Atlantic	
Type of Regulation	Support	Oppose	Support	Oppose
Limits on Minimum Size of Fish You Can Keep	92.5%	7.5%	93.2%	6.8%
Limits on the Number of Fish You Can Keep	91.1%	8.9%	88.3%	11.7%
Limits on the Time of Year When You Can Keep the Fish You Catch	78.8%	21.2%	77.1%	22.9%
Limits on the Areas You Can Catch Fish	67.9%	32.1%	66.0%	34.0%

Source: Steinback and O'Neil. MS.

Table 45. The percentage (%) contribution of bluefish to the total catch by party/charter vessels by state and month, 1996.

STATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
CT	0.00%	0.00%	0.00%	0.00%	4.97%	44.29%	68.63%	75.90%	75.22%	81.84%	37.21%	-	67.88%
DE	-	-	-	1.96%	1.12%	2.42%	0.15%	0.10%	0.00%	0.00%	-	-	0.85%
ME	-	0.00%	0.00%	0.00%	0.12%	0.74%	0.54%	2.96%	0.12%	0.00%	0.00%	0.00%	0.95%
MD	-	-	-	-	2.45%	1.52%	0.25%	0.50%	9.38%	-	-	0.00%	1.31%
MA	0.00%	0.00%	0.00%	0.00%	0.19%	1.50%	8.55%	8.81%	3.52%	0.81%	0.00%	0.00%	3.45%
NH	-	-	-	0.00%	0.00%	0.80%	7.89%	21.78%	4.60%	1.34%	-	-	6.56%
NJ	0.00%	0.00%	0.00%	0.04%	18.24%	26.39%	24.56%	24.15%	14.27%	5.74%	2.75%	0.00%	16.96%
NY	0.00%	0.00%	0.00%	1.69%	6.48%	10.41%	11.04%	11.10%	9.09%	7.21%	1.77%	0.00%	9.12%
NC	0.00%	0.00%	0.00%	0.00%	16.33%	11.23%	17.41%	27.79%	32.43%	0.00%	56.59%	-	15.63%
RI	0.00%	0.00%	0.00%	0.00%	0.17%	8.03%	11.85%	38.79%	10.85%	17.55%	3.81%	0.00%	16.65%
ALL	0.00%	0.00%	0.00%	0.38%	9.25%	16.47%	18.32%	19.70%	13.07%	7.20%	2.57%	0.00%	13.46%

Source: Unpublished NMFS vessel trip report data.

Table 46. Projected bluefish yields and biomass levels associated with a 9 year reduction in fishing mortality from 1999 to 2007.

Year	Fishing Mortality	Projected Yields (m lbs)	Projected Biomass (m lbs)
1999	0.51	36.84	63.67
2000	0.51	43.08	73.68
2001	0.41	41.42	85.08
2002	0.41	50.68	106.28
2003	0.41	59.72	128.66
2004	0.31	53.51	149.36
2005	0.31	64.35	185.03
2006	0.31	73.72	216.05
2007	0.31	81.15	241.19

Source: Gibson and Lazar (1998a).

Table 47. Associated total allowable catch (TAC), total allowable landings (TAL), recreational harvest limit, commercial quota, and projected gross exvessel revenues (7% discount rate) for various rebuilding schedules for bluefish.

Rebuilding schedules	1999	2000	2001	2002	2003	2004	2005	2006	2007
Graduated reduction in fishing mortality of 40% over a nine year period (1999 to 2007) (preferred alternative, sections 3.1.1.2 and 3.1.4.1.1)									
TAC (million lbs)	36.84	43.08	41.42	50.68	59.72	53.51	64.35	73.72	81.15
Discards (million lbs)[a]	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82
TAL (million lbs)[b]	35.02	41.26	39.60	48.86	57.90	51.69	62.53	71.90	79.33
Comm. quota without transfers (million lbs)	5.95	7.01	6.73	8.31	9.84	8.79	10.63	12.22	13.49
Cumulative (million lbs)	5.95	12.97	19.70	28.01	37.85	46.64	57.27	69.49	82.98
Revenues ($)[c]	1,669,142	1,837,868	1,648,797	1,901,194	2,105,494	1,756,475	1,986,061	2,134,246	2,200,723
Cumulative ($)	1,669,142	3,507,009	5,155,807	7,057,001	9,162,495	10,918,970	12,905,031	15,039,277	17,240,000
Comm. quota with transfers (million lbs)[d]	10.50	10.50	10.50	10.50	10.50	10.50	10.63	12.22	13.49
Cumulative (million lbs)	10.50	21.00	31.50	42.00	52.50	63.00	73.63	85.85	99.34
Revenues ($)[c]	2,943,925	2,751,332	2,571,338	2,403,120	2,245,906	2,098,978	1,986,061	2,134,246	2,200,723
Cumulative ($)	2,943,925	5,695,257	8,266,596	10,669,715	12,915,622	15,014,600	17,000,661	19,134,906	21,335,630
Rec. harvest limit without transfer (million lbs)	29.07	34.24	32.87	40.56	48.06	42.90	51.90	59.68	65.85
Cumulative (million lbs)	29.07	63.31	96.18	136.74	184.80	227.70	279.60	339.28	405.13
Rec. harvest limit with transfer (million lbs)	24.52	30.76	29.10	38.36	47.40	41.19	51.90	59.68	65.85
Cumulative (million lbs)	24.52	55.28	84.38	122.75	170.15	211.34	263.24	322.92	388.76
Reduction in fishing mortality by 75% over a five year period (1999-2003) (non-preferred alternative, sections 3.1.2.11.1 and 3.1.5.11.1)									
TAC (million lbs)[e]	30.42	26.08	27.58	27.82	36.46	105.47	101.77	99.87	98.33
Discards (million lbs)[a]	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82
TAL (million lbs)[b]	28.60	24.26	25.76	26.00	34.64	103.65	99.95	98.05	96.51
Comm. quota without transfers (million lbs)	4.86	4.12	4.38	4.42	5.89	17.62	16.99	16.67	16.41
Cumulative (million lbs)	4.86	8.99	13.37	17.79	23.68	41.30	58.29	74.96	91.36
Revenues ($)[c]	1,363,358	1,080,701	1,072,412	1,011,690	1,259,752	3,522,356	3,174,289	2,910,348	2,677,141
Cumulative ($)	1,363,358	2,444,060	3,516,472	4,528,162	5,787,914	9,310,270	12,484,559	15,394,907	18,072,048
Comm. quota with transfers (million lbs)[d]	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
Cumulative (million lbs)	10.50	21.00	31.50	42.00	52.50	63.00	73.50	84.00	94.50
Revenues ($)[c]	2,943,925	2,751,332	2,571,338	2,403,120	2,245,906	2,098,978	1,961,662	1,833,329	1,713,391
Cumulative ($)	2,943,925	5,695,257	8,266,596	10,669,715	12,915,622	15,014,600	16,976,262	18,809,590	20,522,982
Rec. harvest limit without transfer (million lbs)	23.74	20.14	21.38	21.58	28.75	86.03	82.95	81.38	80.10
Cumulative (million lbs)	23.74	43.88	65.26	86.84	115.60	201.62	284.58	365.96	446.06
Rec. harvest limit with transfer (million lbs)	18.10	13.76	15.26	15.50	24.14	93.15	89.45	87.55	86.01
Cumulative (million lbs)	18.10	31.86	47.12	62.63	86.77	179.92	269.37	356.92	442.92

Table 47. (continued). Associated total allowable catch (TAC), total allowable landings (TAL), recreational harvest limit, commercial quota, and projected gross exvessel revenues (7% discount rate) for various rebuilding schedules for bluefish.

Rebuilding schedules	1999	2000	2001	2002	2003	2004	2005	2006	2007
Constant harvest strategy throughout the entire recovery period until the stock is recovered (1999-2004) (non-preferred alternative, sections 3.1.2.11.2 and 3.1.5.11.2)									
TAC (million lbs)[f]	32.00	32.00	32.00	32.00	32.00	101.52	101.94	101.61	101.59
Discards (million lbs)[a]	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82
TAL (million lbs)[b]	30.18	30.18	30.18	30.18	30.18	99.70	100.12	99.79	99.77
Comm. quota without transfers (million lbs)	5.13	5.13	5.13	5.13	5.13	16.95	17.02	16.96	16.96
Cumulative (million lbs)	5.13	10.26	15.39	20.52	25.65	42.60	59.62	76.59	93.55
Revenues ($)[c]	1,438,486	1,344,379	1,256,429	1,174,233	1,097,414	3,388,248	3,179,890	2,962,044	2,767,654
Cumulative ($)	1,438,486	2,782,865	4,039,295	5,213,528	6,310,942	9,699,190	12,879,080	15,841,125	18,608,779
Comm. quota with transfers (million lbs)[d]	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
Cumulative (million lbs)	10.50	21.00	31.50	42.00	52.50	63.00	73.50	84.00	94.50
Revenues ($)[c]	2,943,925	2,751,332	2,571,338	2,403,120	2,245,906	2,098,978	1,961,662	1,833,329	1,713,391
Cumulative ($)	2,943,925	5,695,257	8,266,596	10,669,715	12,915,622	15,014,600	16,976,262	18,809,590	20,522,982
Rec. harvest limit without transfer (million lbs)	25.05	25.05	25.05	25.05	25.05	82.75	83.10	82.83	82.81
Cumulative (million lbs)	25.05	50.10	75.15	100.20	125.25	208.00	291.10	373.93	456.74
Rec. harvest limit with transfer (million lbs)	19.68	19.68	19.68	19.68	19.68	89.20	89.62	89.29	89.27
Cumulative (million lbs)	19.68	39.36	59.04	78.72	98.40	187.60	277.22	366.52	455.78
Constant fishing mortality (F=0.23) over a five year period (1999-2003) (non-preferred alternative, sections 3.1.2.11.3 and 3.1.5.11.3)									
TAC (million lbs)[g]	19.15	28.46	39.33	50.68	60.63	96.45	96.50	96.39	96.45
Discards (million lbs)[a]	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82
TAL (million lbs)[b]	17.33	26.64	37.51	48.86	58.81	94.63	94.68	94.57	94.63
Comm. quota without transfers (million lbs)	2.95	4.53	6.38	8.31	10.00	16.09	16.09	16.08	16.09
Cumulative (million lbs)	2.95	7.48	13.85	22.16	32.16	48.24	64.34	80.41	96.50
Revenues ($)[c]	825,978	1,186,764	1,561,605	1,901,194	2,138,362	3,215,930	3,006,943	2,806,955	2,625,157
Cumulative ($)	825,978	2,012,742	3,574,347	5,475,542	7,613,904	10,829,834	13,836,777	16,643,732	19,268,889
Comm. quota with transfers (million lbs)[d]	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50
Cumulative (million lbs)	10.50	21.00	31.50	42.00	52.50	63.00	73.50	84.00	94.50
Revenues ($)[c]	2,943,925	2,751,332	2,571,338	2,403,120	2,245,906	2,098,978	1,961,662	1,833,329	1,713,391
Cumulative ($)	2,943,925	5,695,257	8,266,596	10,669,715	12,915,622	15,014,600	16,976,262	18,809,590	20,522,982
Rec. harvest limit without transfer (million lbs)	14.38	22.11	31.13	40.56	48.81	78.54	78.58	78.49	78.54
Cumulative (million lbs)	14.38	36.50	67.63	108.19	157.00	235.54	314.12	392.61	471.16
Rec. harvest limit with transfer (million lbs)	6.83	16.14	27.01	38.36	48.31	84.13	84.18	84.07	84.13
Cumulative (million lbs)	6.83	22.97	49.98	88.35	136.65	220.79	304.96	389.03	473.16

Table 47. (continued). Associated total allowable catch (TAC), total allowable landings (TAL), recreational harvest limit, commercial quota, and projected gross exvessel revenues (7% discount rate) for various rebuilding schedules for bluefish.

Rebuilding schedules	1999	2000	2001	2002	2003	2004	2005	2006	2007
Constant fishing mortality (F=0.36) over a nine year period (1999-2007) (non-preferred alternative, sections 3.1.2.11.4 and 3.1.5.11.4)									
TAC (million lbs)	27.87	37.21	47.55	57.72	67.31	75.91	82.74	88.07	91.23
Discards (million lbs)[a]	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82
TAL (million lbs)[b]	26.05	35.39	45.73	55.90	65.49	74.09	80.92	86.25	89.41
Comm. quota without transfers (million lbs)	4.43	6.02	7.77	9.50	11.13	12.59	13.76	14.66	15.20
Cumulative (million lbs)	4.43	10.44	18.22	27.72	38.85	51.45	65.21	79.87	95.07
Revenues ($)[c]	1,241,465	1,576,640	1,903,949	2,174,822	2,381,262	2,517,669	2,570,022	2,560,251	2,480,214
Cumulative ($)	1,241,465	2,818,106	4,722,055	6,896,877	9,278,139	11,795,808	14,365,830	16,926,082	19,406,295
Comm. quota with transfers (million lbs)[d]	10.50	10.50	10.50	10.50	11.13	12.59	13.76	14.66	15.20
Cumulative (million lbs)	10.50	21.00	31.50	42.00	53.13	65.73	79.48	94.15	109.35
Revenues ($)[c]	2,943,925	2,751,332	2,571,338	2,403,120	2,381,262	2,517,669	2,570,022	2,560,251	2,480,214
Cumulative ($)	2,943,925	5,695,257	8,266,596	10,669,715	13,050,978	15,568,647	18,138,669	20,698,921	23,179,134
Rec. harvest limit without transfer (million lbs)	21.62	29.38	37.96	46.39	54.35	61.49	67.16	71.59	74.21
Cumulative (million lbs)	21.62	51.00	88.95	135.35	189.70	251.19	318.36	389.95	464.16
Rec. harvest limit with transfer (million lbs)	15.55	24.89	35.23	45.40	54.35	61.49	67.16	71.59	74.21
Cumulative (million lbs)	15.55	40.44	75.67	121.07	175.43	236.92	304.08	375.67	449.88

[a] Assume constant discards throughout the time period of analysis.
[b] TAL = TAC - Discards.
[c] Assume bluefish exvessel price of $0.30 per pound.
[d] The commercial allocation will be set at 10.50 million lbs until 17% of the TAL is greater than 10.50 million lbs.
[e] Assume projected yields of 36.46 million lbs after recovery period (2004 to 2007).
[f] Assume projected yields of 32.00 million lbs after recovery period (2005 to 2007).
[g] Assume projected yields of 60.63 million lbs after recovery period (2004 to 2007).

Table 48. State-bystate commercial bluefish quotas (lbs) for 1999 based on coastwide quotas of 5,953,473 lbs (F=0.51) and 10,500,618 (F=0.51, allowing increase in landings by up to 10.50 million pounds). State shares are based on 1987-1989 landings from NMFS General Canvass Data and assume no *de minimus* states.

STATE	POUNDS	%	QUOTA Without Increase in Landings[a]	QUOTA Allowing for Increase in Landings[b]
ME	858,177	0.6685	39,802	70,202
NH	532,032	0.4145	24,675	43,522
MA	8,621,803	6.7167	399,876	705,294
RI	8,739,090	6.8081	405,316	714,888
CT	1,625,500	1.2663	75,390	132,972
NY	13,330,736	10.3851	618,275	1,090,501
NJ	19,018,645	14.8162	882,078	1,555,792
DE	2,410,900	1.8782	111,817	197,220
MD	3,853,253	3.0018	178,712	315,210
VA	15,248,930	11.8795	707,240	1,247,416
NC	41,154,504	32.0608	1,908,731	3,366,582
SC	45,161	0.0352	2,095	3,694
GA	12,205	0.0095	566	998
FL	12,912,995	10.0597	598,900	1,056,328
TOTAL	**128,363,931**	**100**	**5,953,473**	**10500,618**

[a]Allocation based on historic proportion of commercial landings for the 1981-1989 period.

[b]Allocation based on the assumptions that the recreational fishery is not projected to land their entire allocation of 29.07 million pounds in 1999, therefor increasing commercial fishery quota by up to 10.50 million pounds.

Table 49. State-by-state commercial bluefish quotas (lbs) for 1999 based on coastwide quotas of 5,953,473 lbs (F=0.51) and 10,500,618 (F=0.51, allowing increase in landings by up to 10.50 million pounds). State shares are based on 1981-1993 landings from NMFS General Canvass Data.

STATE	POUNDS	%	QUOTA Without Increase in Landings[a]	QUOTA Allowing for Increase in Landings[b]
ME	1,141,889	0.6440	38,339	67,622
NH	1,247,039	0.7033	41,870	73,849
MA	12,047,787	6.7945	404,510	713,467
RI	14,159,895	7.9857	475,425	838,545
CT	2,501,235	1.4106	83,980	148,122
NY	19,563,457	11.0331	656,852	1,158,542
NJ	28,026,949	15.8062	941,018	1,659,748
DE	3,043,900	1.7166	102,200	180,259
MD	4,712,018	2.6574	158,208	279,044
VA	17,852,734	10.0683	599,414	1,057,234
NC	55,196,727	31.1290	1,853,255	3,268,735
SC	50,135	0.0283	1,683	2,969
GA	13,761	0.0078	462	815
FL	17,758,711	10.0153	596,257	1,051,666
TOTAL	**177,316,307**	**100**	**5,953,473**	**10,500,618**

[a]Allocation based on historic proportion of commercial landings for the 1981-1989 period.

[b]Allocation based on the assumptions that the recreational fishery is not projected to land their entire allocation of 29.07 million pounds in 1999, therefor increasing commercial fishery quota by up to 10.50 million pounds.

Table 50. State-by-state commercial bluefish quotas (lbs) for 1999 based on coastwide quotas of 5953473 lbs (F=0.51) and 10500618 (F=0.51, allowing increase in landings by up to 10.50 million pounds). State shares are based on 1985-1989 landings from NMFS General Canvass Data.

STATE	POUNDS	%	QUOTA Without Increase in Landings[a]	QUOTA Allowing for Increase in Landings[b]
ME	384,577	0.5589	33,273	58,686
NH	371,832	0.5404	32,170	56,741
MA	5,204,303	7.5631	450,267	794,173
RI	6,250,890	9.0840	540,816	953,881
CT	843,700	1.2261	72,995	128,748
NY	7,004,836	10.1797	606,046	1,068,933
NJ	11,586,745	16.8383	1,002,465	1,768,129
DE	1,256,200	1.8256	108,684	191,695
MD	2,633,153	3.8266	227,816	401,817
VA	7,637,930	11.0998	660,821	1,165,542
NC	19,946,283	28.9867	1,725,718	3,043,788
SC	19,594	0.0285	1,695	2,990
GA	8,312	0.0121	719	1,268
FL	5,663,372	8.2302	489,985	864,226
TOTAL	**68,811,727**	**100**	**5,953,473**	**10,500,618**

[a]Allocation based on historic proportion of commercial landings for the 1981-1989 period.

[b]Allocation based on the assumptions that the recreational fishery is not projected to land their entire allocation of 29.07 million pounds in 1999, therefor increasing commercial fishery quota by up to 10.50 million pounds.

Table 51. Projected bluefish yields and biomass levels associated with a 5 year step reduction in fishing mortality from 1999 to 2003.

Year	Fishing Mortality Schedule	Projected Yields (million lbs)	Projected Biomass Level (million lbs)
1999	0.40	30.42	63.49
2000	0.25	26.08	82.39
2001	0.18	27.58	120.57
2002	0.13	27.82	175.44
2003	0.13	36.46	243.39

Source: Gibson and Lazar (1998b).

Table 52. Projected bluefish yields and biomass levels associated with a constant catch strategy of 32 million pounds from 1999 to 2004.

Year	Fishing Mortality Schedule	Projected Yields (m lbs)	Projected Biomass Level (m lbs)
1999	0.46	32.00	61.11
2000	0.35	32.00	76.50
2001	0.35	32.00	103.90
2002	0.25	32.00	147.97
2003	0.18	32.00	207.85
2004	0.10	101.52	274.26

Source: Gibson and Lazar (1998b).

Table 53. Projected bluefish yields and biomass levels associated with a 5 year constant fishing mortality (F=0.23) from 1999 to 2003.

Year	Fishing Mortality Schedule	Projected Yields (million lbs)	Projected Biomass Level (million lbs)
1999	0.23	19.15	63.67
2000	0.23	28.46	97.18
2001	0.23	39.33	140.70
2002	0.23	50.68	188.50
2003	0.23	60.63	235.23

Source: Gibson and Lazar (1998b).

Table 54. Projected bluefish yields and biomass levels associated with a 9 year constant fishing mortality (F=0.36) from 1999 to 2007.

Year	Fishing Mortality Schedule	Projected Yields (million lbs)	Projected Biomass Level (million lbs)
1999	0.36	27.87	63.67
2000	0.36	37.21	85.76
2001	0.36	47.55	112.22
2002	0.36	57.72	141.18
2003	0.36	67.31	168.15
2004	0.36	75.91	192.68
2005	0.36	82.74	213.50
2006	0.36	88.07	227.30
2007	0.36	91.23	238.98

Source: Gibson and Lazar (1998b).

Table 55. Cetaceans and Turtles found in Survey Area.

Scientific Name	Common Name	Estimated Minimum Number in Study Area	Endangered	Threatened
LARGE WHALES				
Balaenoptera physalus	fin whale	1,102	X	
Megaptera novaeangliae	humpback whale	684	X	
Balaenoptera acutorostrata	minke whale	162		
Physeter catodon	sperm whale	300	X	
Eubalaena glacialis	right whale	29	X	
Balaenoptera borealis	sei whale	109	X	
Orcinus orca	killer whale	unk		
SMALL WHALES				
Tursiops truncatus	bottlenose dolphin	6,254		
Globicephala spp.	pilot whales	11,448		
Lagenorhynchus acutus	Atl. white-sided dolphin	24,287		
Phocoena	harbor porpoise	2,946		
Grampus griseus	grampus (Risso's) dolphin	10,220		
Delphinus delphis	saddleback dolphin	17,606		
Stenella spp.	spotted dolphin	22,376		
Stenella coeruleoalba	striped dolphin	unk		
Lagenorhynchus albirostris	white-beaked dolphin	unk		
Ziphius cavirostris	Cuvier's beaked dolphin	unk		
Stenella longirostris	spinner dolphin	unk		
Steno bredanensis	rough-toothed dolphin	unk		
Delphinapteras leucas	beluga	unk		
Mesoplodon spp.	beaked whales	unk		
TURTLES				
Caretta caretta	loggerhead turtle	4,017		X
Dermochelys coriacea	leatherback turtle	636	X	
Lepidochelys kempi	Kemp's ridley turtle	unk	X	
Chelonia mydas	green turtle	unk		X

Source: University of Rhode Island 1982.

Table 56. The percent of measured bluefish (TL in) less than a given size based on 1987-1996* NEFSC weighout data.

YEAR	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	N
1986	-	-	-	-	-	-	-	-	0.2	2.7	15.9	40.3	49.5	54.4	55.9	57.4	59.1	62.2	1838
1987	-	-	-	-	-	-	-	-	-	-	-	9.4	23.7	36.6	42.9	48.7	51.1	55.6	1105
1988	-	-	-	-	-	1.3	3.4	6.1	6.7	7.8	10.6	18.7	29.9	41.8	47.2	48.8	49.3	49.8	1961
1989	-	-	-	-	-	-	0.3	0.3	1.7	9.3	15.1	34.6	55.3	63.9	69.0	69.3	69.5	69.7	590
1990	-	-	-	-	-	-	-	-	-	-	0.2	1.0	9.2	18.4	26.9	46.8	78.4	96.3	402
1991	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.5	1.5	2.0	201
1992	-	-	-	-	-	-	-	-	-	3.7	41.7	85.0	96.2	98.2	99.2	100.0	100.0	100.0	400
1993	-	-	-	-	-	-	-	-	-	-	-	-	0.5	5.0	26.0	82.5	94.0	98.5	200
1994	-	-	-	-	-	-	-	-	-	0.9	5.8	17.4	21.8	23.5	27.3	32.8	34.9	35.8	763
1995	-	-	-	-	-	-	0.5	3.7	14.8	32.8	39.2	50.8	69.8	90.5	96.8	100.0	100.0	100.0	189
87-96	-	-	-	-	-	0.3	0.9	1.7	2.3	4.5	11.4	26.0	36.7	44.8	49.5	54.3	57.4	59.9	7649

Table 57. The percent of measured bluefish (TL in) less than a given size based on 1987-1996 North Carolina commercial length data.

YEAR	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	N
1987	-	-	-	0.0	0.0	0.1	15.8	37.3	47.7	56.4	61.3	66.8	73.0	77.8	82.8	83.9	84.2	84.6	2843
1988	-	-	-	-	0.0	0.1	4.9	11.5	15.8	19.5	23.1	29.4	36.6	43.0	45.7	47.3	48.8	50.1	3138
1989	-	-	-	0.0	0.0	1.2	11.6	25.8	39.2	53.7	64.3	73.4	78.1	81.2	83.2	83.7	83.8	83.9	4321
1990	-	-	-	0.0	0.2	1.5	21.0	41.3	52.7	61.7	68.0	72.4	75.0	78.6	81.0	81.8	82.1	82.2	6340
1991	0.3	0.3	0.3	0.3	0.5	3.4	9.3	14.7	23.2	39.8	60.5	76.2	86.2	91.7	93.0	93.2	93.3	93.3	4679
1992	0.4	0.5	0.7	1.1	2.8	8.9	23.9	35.5	44.3	51.0	58.8	62.3	66.3	69.6	71.8	73.6	76.0	78.2	5047
1993	-	-	-	0.0	0.1	0.8	2.9	5.1	6.6	10.2	20.2	40.9	59.6	68.3	71.0	72.4	73.8	77.1	2577
1994	-	-	0.6	0.7	1.1	4.3	22.5	45.5	59.9	67.7	71.7	76.5	77.8	79.8	80.3	80.3	80.3	80.6	1359
1995	-	0.0	21.8	90.6	92.9	93.1	93.7	95.6	96.5	97.3	98.1	98.9	99.4	99.5	99.5	99.5	99.5	99.5	1376
1996	0.8	1.7	2.6	3.9	5.0	11.4	25.0	42.5	50.6	53.2	56.0	57.6	58.5	59.2	59.3	59.3	59.4	59.5	2201

Table 58. The percent of measured bluefish (TL) less than a given size based on 1987-1996* NEFSC weighout data for each major gear type.

GEAR	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	N
OT	-	-	-	-	-	0.6	1.8	3.3	4.4	7.1	11.2	25.4	42.1	55.5	61.6	63.7	64.6	66.4	3880
SGN	-	-	-	-	-	-	-	-	-	-	0.2	5.9	10.6	13.4	15.8	25.7	37.6	44.7	1205
PS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.5	389
PN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1	246
LL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	68
RAGN	-	-	-	-	-	-	-	-	0.2	3.6	19.4	42.6	47.7	51.7	56.2	65.7	68.7	71.0	1361
DGN	-	-	-	-	-	-	-	-	-	3.2	34.6	70.4	79.0	81.4	87.4	95.4	98.6	99.8	500

OT = Otter Trawl
SGN = Sink Gill Net
PS = Purse seine
PN = Pound Net
LL = Long Lines
RAGN = Runaround Gill Net
DGN = Drift Gill Net

Table 59. The percent of measured bluefish (TL) less than a given size based on 1987-1996 North Carolina commercial data for each major gear type.

GEAR	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	N
OT	0.3	0.3	0.4	1.3	4.2	7.0	8.2	8.8	10.0	14.8	26.7	38.7	46.1	49.3	51.1	53.5	56.8	61.0	8684
SGN	-	-	-	-	0.5	2.4	4.5	9.2	22.6	40.7	52.0	57.5	59.9	60.3	60.3	60.4	60.5	60.8	13091
PN	-	-	-	-	-	33.1	64.2	82.0	90.2	94.4	96.2	98.1	99.2	99.8	99.8	99.8	99.9	99.9	1640
LHS	-	5.9	24.1	24.9	26.6	39.1	53.7	64.7	75.0	83.4	89.5	93.9	97.0	98.8	99.4	99.6	99.6	99.7	10462

OT = Otter Trawl (Ocean)
SGN = Sink Gill Net (Ocean)
PN = Pound Net
P + T = Pots and Traps
LHS = Long Haul Seine

Table 60. State-by-state commercial bluefish quotas (lbs) for 1999 based on coastwide quotas of 5,953,473 lbs (F=0.51) and 10,500,618 (F=0.51, allowing increase in landings by up to 10.50 million pounds). State shares are based on 1981-1989 landings from NMFS General Canvass Data and assume SC and GA are *de minimus* status.

STATE	POUNDS	%	QUOTA Without Increase in Landings[a]	QUOTA Allowing for Increase in Landings[b]
ME	858,177	0.6675	39,740	70,093
NH	532,032	0.4138	24,637	43,454
MA	8,621,803	6.7063	399,255	704,198
RI	8,739,090	6.7975	404,686	713,777
CT	1,625,500	1.2644	75,273	132,765
NY	13,330,736	10.3690	617,314	1,088,806
NJ	19,018,645	14.7932	880,707	1,553,374
DE	2,410,900	1.8753	111,643	196,914
MD	3,853,253	2.9972	178,435	314,720
VA	15,248,930	11.8610	706,141	1,245,477
NC	41,154,504	32.0110	1,905,766	3,361,351
SC	45,161	0.1000	5,953	10,501
GA	12,205	0.1000	5,953	10,501
FL	12,912,995	10.0440	597,970	1,054,687
TOTAL	**128,363,931**	**100**	**5,953,473**	**10,500,618**

[a]Allocation based on historic proportion of commercial landings for the 1981-1989 period.

[b]Allocation based on the assumptions that the recreational fishery is not projected to land their entire allocation of 29.07 million pounds in 1999, therefor increasing commercial fishery quota by up to 10.50 million pounds.

Table 61. Estimated daily possession limits (fish/day) for the Atlantic Coast recreational bluefish fishery for various size limits based on equivalent conservation relative to the preferred alternative of a 10 fish possession limit in conjunction with a 12 in minimum size limit. Size and possession limit combinations necessary to achieve F=0.4 in 1999 are specified.

Minimum size limit (TL in)	Daily Possession Limit F=0.4
6	8
8	9
10	9
12	10
14	11
16	13
18	16
20	20

Source: Crecco (pers. comm.)

Table 62. The percent of measured bluefish (TL) less than a given size based on 1987-1996* MRFSS intercept data.

ST	TOTAL INCHES																	
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	N
ME	-	-	-	-	-	-	-	-	-	-	-	-	0.6	2.7	3.3	5.7	11.7	17.4	334
NH	-	-	-	-	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.4	0.6	1.6	2.4	3.4	500
MA	0.1	0.5	1.0	1.7	2.1	2.5	2.5	2.6	2.7	2.9	3.4	4.4	6.4	8.8	12.0	16.0	19.5	23.0	3755
RI	1.6	7.5	15.1	22.0	26.7	29.1	29.8	30.9	33.8	35.9	37.2	37.8	39.0	41.1	43.5	46.1	49.2	53.1	2978
CT	3.9	10.9	17.8	21.9	23.0	23.7	23.8	23.9	24.1	24.5	25.1	26.2	26.9	28.4	30.1	32.4	34.8	38.9	4917
NY	3.9	10.8	22.0	32.1	37.7	39.9	40.7	41.3	42.4	44.6	47.6	50.6	53.7	58.6	63.4	67.9	71.2	74.9	10122
NJ	1.0	2.4	4.9	8.8	12.7	16.2	19.1	22.3	27.4	32.8	38.5	44.9	49.2	53.6	57.9	62.5	66.7	70.9	4712
DE	0.1	0.1	0.1	0.7	1.6	3.4	7.9	18.3	32.5	48.7	257.7	66.2	71.1	76.2	82.2	87.0	89.7	91.0	3325
MD	-	-	0.1	0.4	1.3	2.5	4.8	8.8	13.1	18.4	24.5	30.9	36.6	43.4	50.1	56.7	61.4	66.3	3598
VA	-	0.2	0.7	2.7	6.9	14.1	24.7	39.2	49.0	55.6	60.3	64.5	68.1	72.3	74.6	75.9	77.1	78.3	3257
NC	0.1	0.2	0.5	2.2	5.5	11.2	20.8	34.7	46.7	60.5	69.4	76.9	80.8	84.4	85.6	86.1	86.5	87.0	12622
SC	0.5	0.5	0.8	2.0	4.8	11.4	19.7	34.9	50.6	66.6	75.9	83.0	88.1	90.1	91.1	91.9	92.4	92.4	395
GA	0.2	0.2	3.5	8.3	13.0	25.5	37.6	51.1	60.3	66.9	71.4	74.2	76.8	77.3	77.8	77.8	77.8	77.8	423
FL	-	-	-	0.3	1.0	1.8	4.5	10.8	34.1	47.5	56.3	68.3	75.3	81.6	85.7	91.2	92.2	93.8	2027
Coast	1.3	3.8	7.4	11.2	14.2	17.3	21.4	27.5	34.1	40.9	46.0	50.9	54.4	58.3	61.5	64.6	67.0	69.6	52965

Table 63. The percent reduction in exploitation associated with various size limits for bluefish, 1987-1996*. The reductions are based on measured fish from the MRFSS survey and assume a post-release mortality of 15%.

Size (TL in)	PR
6	1.1
7	3.2
8	6.3
9	9.5
10	12.1
11	14.7
12	18.2
13	23.4
14	29.0
15	34.8
16	39.1
17	43.3
18	46.2
19	49.6
20	52.3
21	54.9
22	57.0
23	59.2

Table 64. The percent of successful anglers landing 1 to 250 bluefish (MRFSS A fish) per day, coastwide, 1985-1989.

C_PER_T	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1	6616	41.2	6616	41.2
2	2596	16.2	9212	57.4
3	1522	9.5	10734	66.9
4	834	5.2	11568	72.1
5	910	5.7	12478	77.8
6	478	3.0	12956	80.7
7	412	2.6	13368	83.3
8	454	2.8	13822	86.1
9	108	0.7	13930	86.8
10	558	3.5	14488	90.3
11	105	0.7	14593	90.9
12	158	1.0	14751	91.9
13	179	1.1	14930	93.0
14	109	0.7	15039	93.7
15	206	1.3	15245	95.0
16	67	0.4	15312	95.4
17	89	0.6	15401	96.0
18	84	0.5	15485	96.5
19	36	0.2	15521	96.7
20	163	1.0	15684	97.7
21	23	0.1	15707	97.9
22	27	0.2	15734	98.0
23	32	0.2	15766	98.2
24	17	0.1	15783	98.3
25	63	0.4	15846	98.7
26	8	0.0	15854	98.8
27	9	0.1	15863	98.8
28	27	0.2	15890	99.0
29	5	0.0	15895	99.0
30	47	0.3	15942	99.3
31	10	0.1	15952	99.4
32	5	0.0	15957	99.4
33	9	0.1	15966	99.5
34	4	0.0	15970	99.5
36	1	0.0	15971	99.5
37	6	0.0	15977	99.6
38	3	0.0	15980	99.6
39	2	0.0	15982	99.6
40	21	0.1	16003	99.7
43	3	0.0	16006	99.7
45	2	0.0	16008	99.8
47	1	0.0	16009	99.8
48	1	0.0	16010	99.8
50	11	0.1	16021	99.8
51	2	0.0	16023	99.8
57	4	0.0	16027	99.9
60	2	0.0	16029	99.9
61	1	0.0	16030	99.9
62	1	0.0	16031	99.9
68	3	0.0	16034	99.9
69	6	0.0	16040	100.0
70	2	0.0	16042	100.0
71	1	0.0	16043	100.0
88	1	0.0	16044	100.0
90	1	0.0	16045	100.0
130	1	0.0	16046	100.0
157	1	0.0	16047	100.0
250	1	0.0	16048	100.0

Table 65. The percent reduction in exploitation associated with various possession limits for bluefish, 1985-1989. The reductions assume a post-release mortality of 15%.

BAG	PR
1	65.5
2	54.0
3	45.7
4	39.2
5	33.8
6	29.5
7	25.7
8	22.4
9	19.7
10	17.2
11	15.3
12	13.5
13	11.9
14	10.6
15	9.3
16	8.4
17	7.5
18	6.7
19	6.0
20	5.4

Table 66. Bluefish recreational landings by wave, 1987-1996* combined.

WAVE OF DATA	PERCENT
J-F	1.78
M-A	3.87
M-J	19.09
J-A	40.03
S-O	29.11
N-D	6.11

Table 67. State by state commercial bluefish shares (percentages) based on commercial landings for various time period from NMFS General Canvass Data.

State	A 1981-1989[1]	B 1981-1993[2]	C 1985-1989[3]	D (B-A)	E (C-A)
ME	0.6685	0.6440	0.5589	-0.0245	-0.1096
NH	0.4145	0.7033	0.5404	0.2888	0.1259
MA	6.7167	6.7945	7.5631	0.0778	0.8464
RI	6.8081	7.9857	9.0840	1.1776	2.2759
CT	1.2663	1.4106	1.2261	0.1443	-0.0402
NY	10.3851	11.0331	10.1797	0.6480	-0.2054
NJ	14.8162	15.8062	16.8383	0.9900	2.0221
DE	1.8782	1.7166	1.8256	-0.1616	-0.0526
MD	3.0018	2.6574	3.8266	-0.3444	0.8248
VA	11.8795	10.0683	11.0998	-1.8112	-0.7797
NC	32.0608	31.1290	28.9867	-0.9318	-3.0741
SC	0.0352	0.0283	0.0285	-0.0069	-0.0067
GA	0.0095	0.0078	0.0121	-0.0017	0.0026
FL	10.0597	10.0153	8.2302	-0.0444	-1.8295
Total	100	100	100		

[1]Preferred alternative, section 3.1.4.1.8.
[2]Non-preferred alternative, section 3.1.5.6.
[3]Non-preferred alternative, section 3.1.5.7.

Table 68. The percentage of bluefish measured greater than maximum size limits ranging from 20-36 inches (TL) in the recreational and commercial fisheries along the Atlantic coast from 1987-1996*.

Maximum Size Limit	Recreational	Commercial
20	35.4	45.7
21	33.0	42.6
22	30.4	40.1
23	28.1	37.8
24	25.6	34.1
25	23.5	31.7
26	21.4	30.1
27	19.4	27.9
28	17.3	23.2
29	15.6	18.7
30	13.4	14.0
31	11.1	10.7
32	8.0	6.1
33	5.5	3.3
34	3.5	1.3
35	2.1	0.3
36	1.1	0.0

*Source: MRFSS and unpublished NMFS weighout data.

Table 69. Summary of state regulations pertaining to bluefish (as of August 1996).

State	Quota%	Commercial Size	License	Other	Possession	Recreational Size
Maine	0.641[1]		yes		10	
New Hampshire	0.718[2]		yes	A	10	
Massachusetts	7.160[3]		yes	B	10	
Rhode Island	8.876		yes		10	
Connecticut	1.269		yes		10	
New York	11.086[4]	9"	yes	C	10	
New Jersey	16.264[5]		yes	D	10	
Delaware	1.682		yes	E	10	
Maryland	2.863	8" TL	yes	F	10	8"TL
Potomac River Fisheries Comm.	none[6]	8"	yes		10	8"
Virginia	9.536		yes		10	
North Carolina	30.714		yes		10	12"
South Carolina	0.028[7]		yes		10	
Georgia	0.007[8]		yes		15	12"FL
Florida	9.155[9]		yes		10	12"FL

A. New Hampshire has a July-September season.
B. Massachusetts imposes a 5,000 pound trip limit and requires reporting.
C. New York prohibits pair trawls, imposes a January 1-October 15 season, excluding otter trawls. For otter trawls, the season is July 1-November 15. There is a 100 pound bycatch allowance during closed seasons.
D. New Jersey imposes commercial seasons: gill nets January 1-November 6; otter trawls January 1-December 7; hook and line June 16-August 7; pound nets January 1-December 31. Purse seines have no seasons, the use of this gear will be prohibited when 117,000 pound of bluefish have been landed using purse seines.
E. Delaware will prohibit the use of gill nets a total of 35 days, dispersed throughout the months of May and June. Delaware also has limited entry, gill net yardage restrictions, and reporting is required.
F. Maryland requires monthly reporting.

1. Maine has been granted *de minimus* status regarding the commercial quota and allocated 100,000 pounds. Landings are monitored and reported annually.
2. New Hampshire is allocated a quota of 162,000 pounds.
3. Massachusetts is allocated a quota of 686,189 pounds.
4. New York is allocated a quota of 1,062,359 pounds.
5. New Jersey is allocated a quota of 1,558,589 pounds, this quota is controlled by seasons for specific gear types.
6. PRFC has no state quota share. Landings are reported against Virginia and Maryland. The PRFC can close the fishery upon notice from Virginia and Maryland.
7. South Carolina is granted *de minimus* status regarding the commercial quota and allocated 20,000 pounds. Landings are monitored and reported annually.
8. Georgia is granted *de minimus* status regarding the commercial quota and allocated 20,000 pounds. Landings are monitored and reported annually.
9. Florida's quota is managed through a 7,500 pound trip limit, net length, number, mesh, and soak time restrictions.

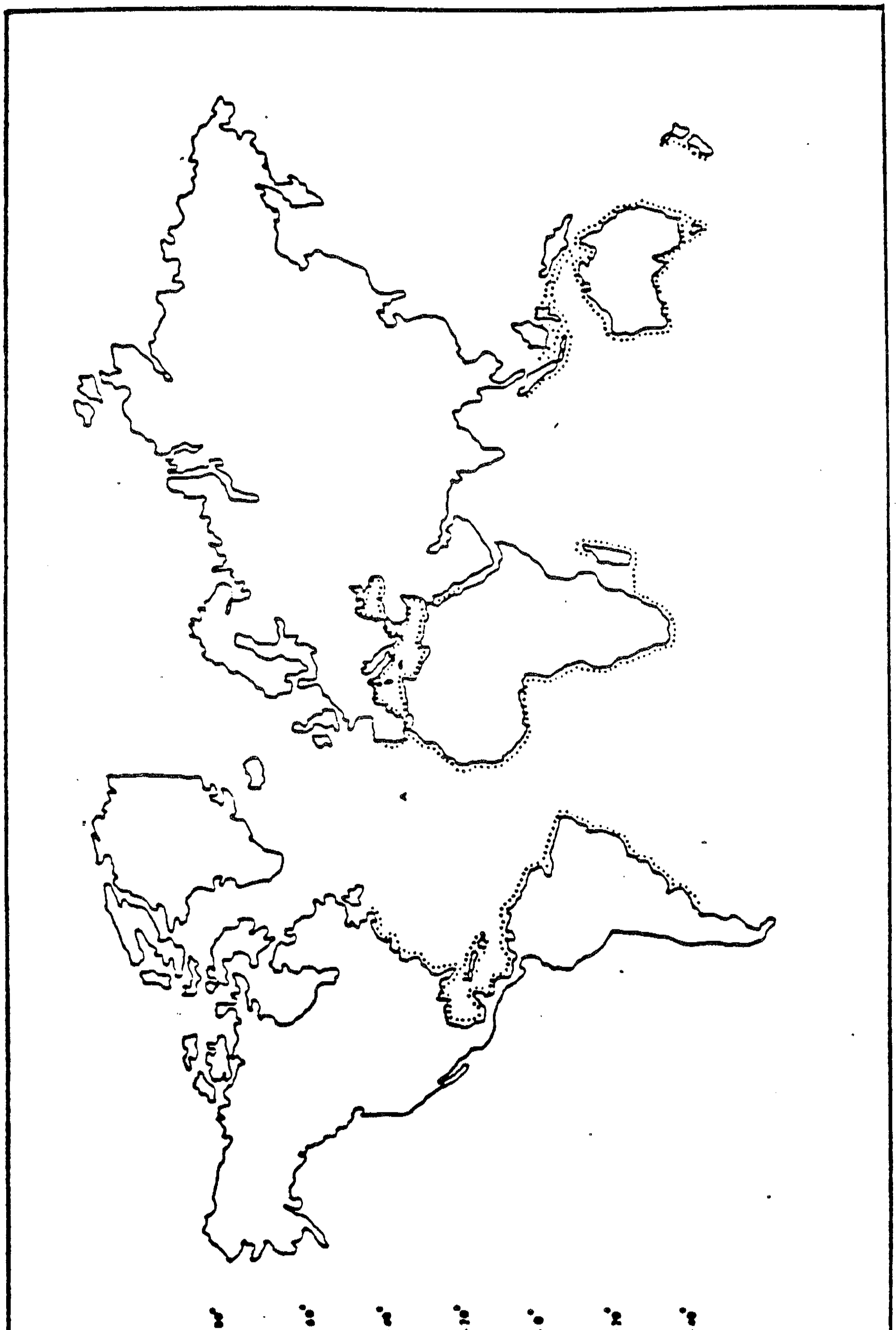

Figure 1. The world distribution of bluefish, indicated by the dotted area
Source: van der Est 1976.

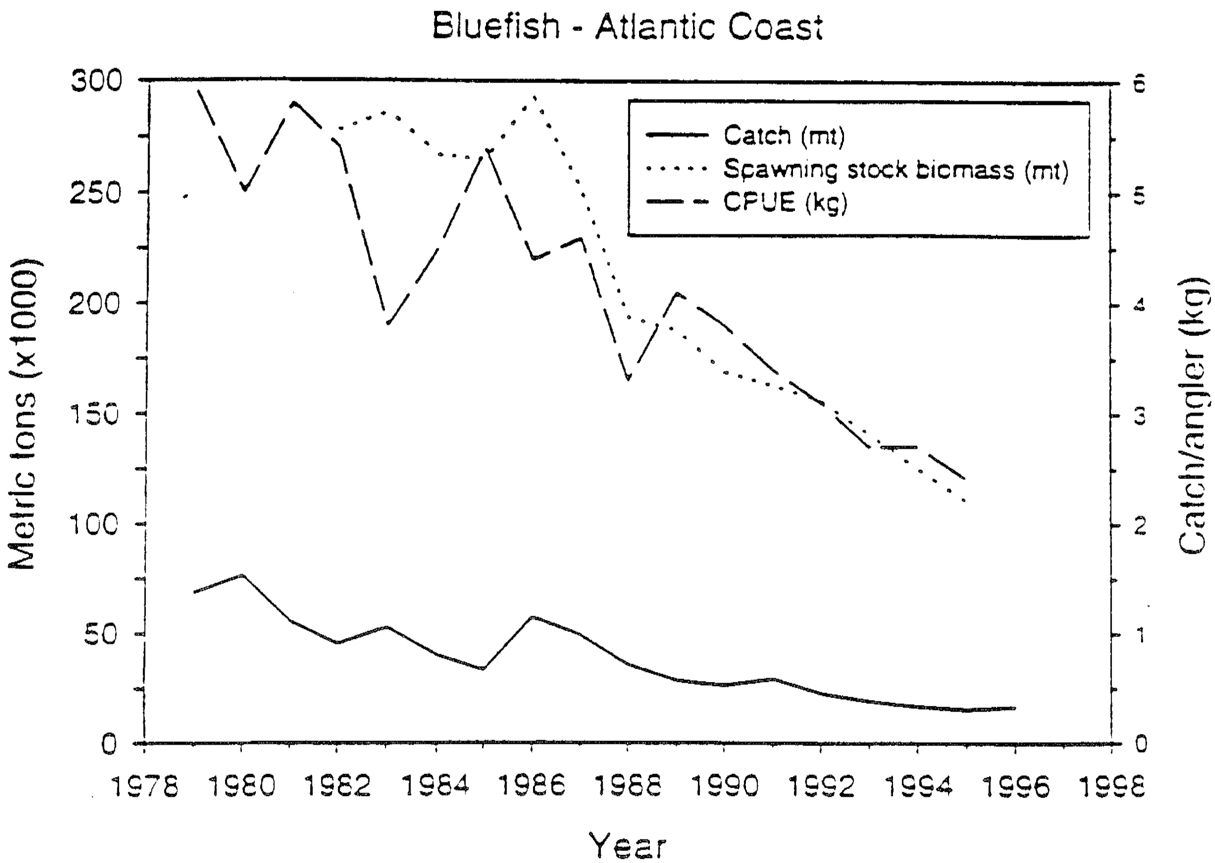

Figure 2. Total bluefish landings (commercial and recreational) for the Atlantic Coast from 1979-1996. Source: Fahay 1998.

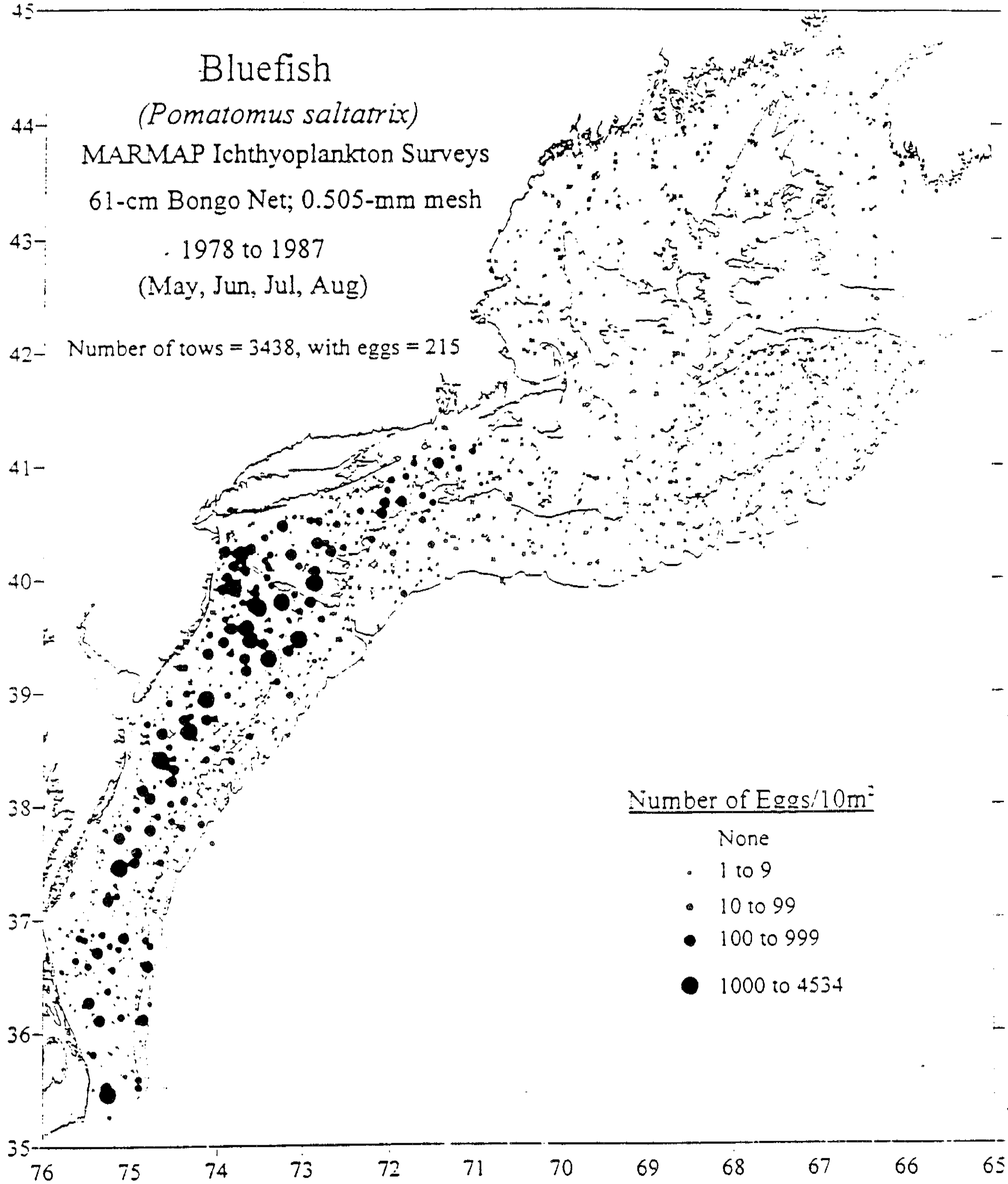

Figure 3. Distribution of bluefish eggs collected from May through August over the MAB continental shelf during the 11 year MARMAP survey.
Source: Fahay 1998.

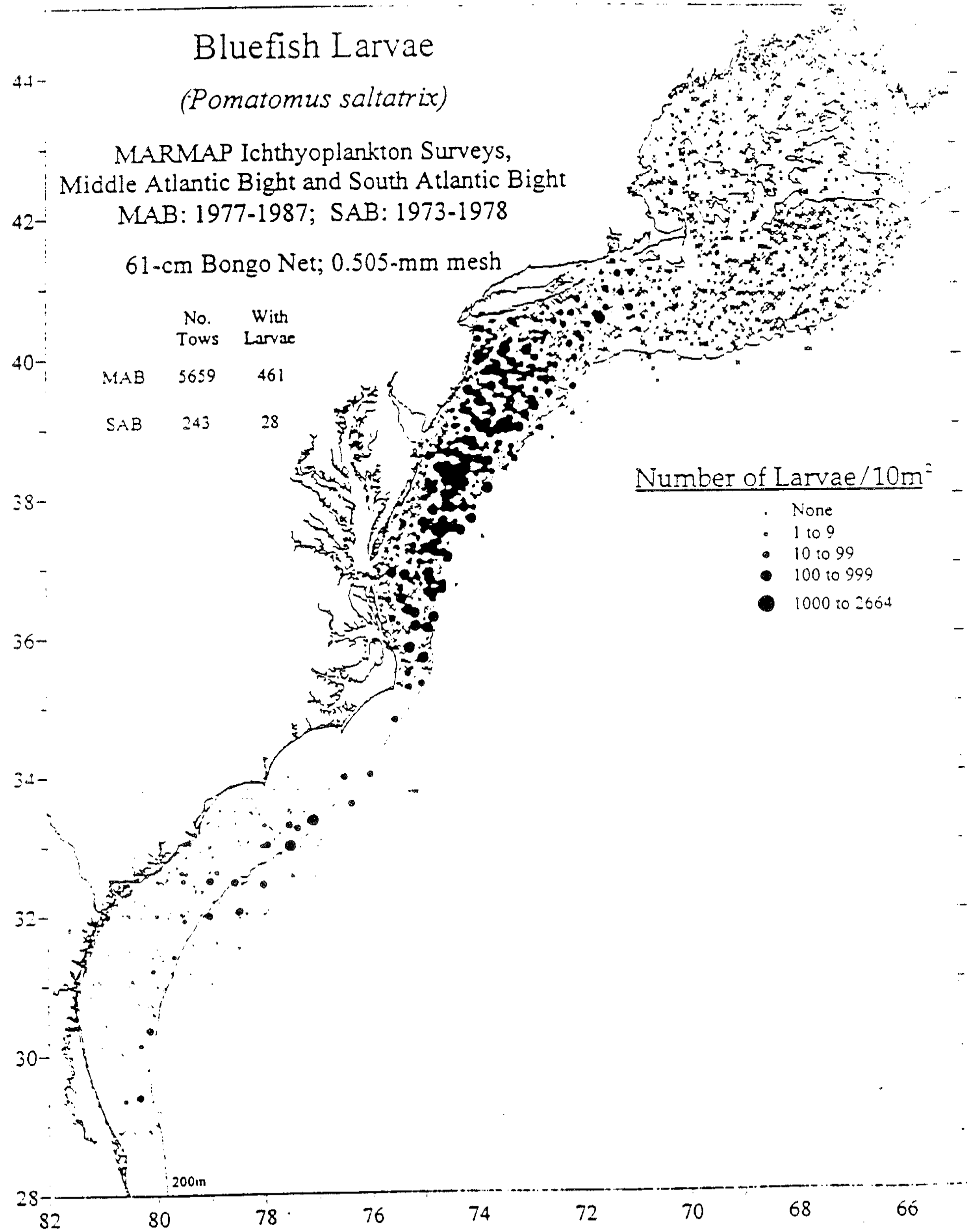

Figure 4. Distribution of all bluefish larvae collected in the MAB and SAB in the MARMAP survey. Source: Fahay 1998.

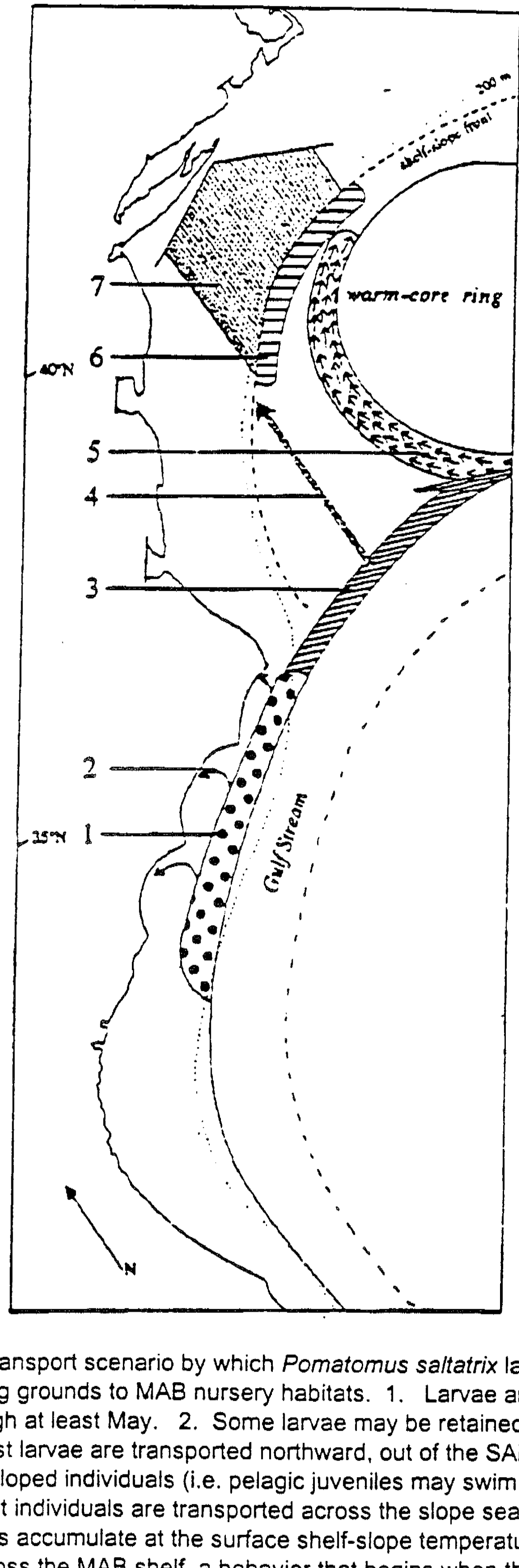

Figure 5. Schematic of proposed transport scenario by which *Pomatomus saltatrix* larvae and pelagic juveniles are transported from SAB spawning grounds to MAB nursery habitats. 1. Larvae are spawned on the outer shelf of the SAB from March through at least May. 2. Some larvae may be retained within the SAB and recruit to estuaries therein. 3. Most larvae are transported northward, out of the SAB, in association with the Gulf Stream. 4. Some, more developed individuals (i.e. pelagic juveniles may swim across the slope sea in warm core ring streamers. 5. Most individuals are transported across the slope sea in warm-core ring streamers. 6. Larvae and juveniles accumulate at the surface shelf-slope temperature front. 7. Larvae and pelagic juveniles actively swim across the MAB shelf, a behavior that begins when the surface shelf-slope temperature from dissipate in late-spring early summer.
Source: Hare and Cowen 1996.

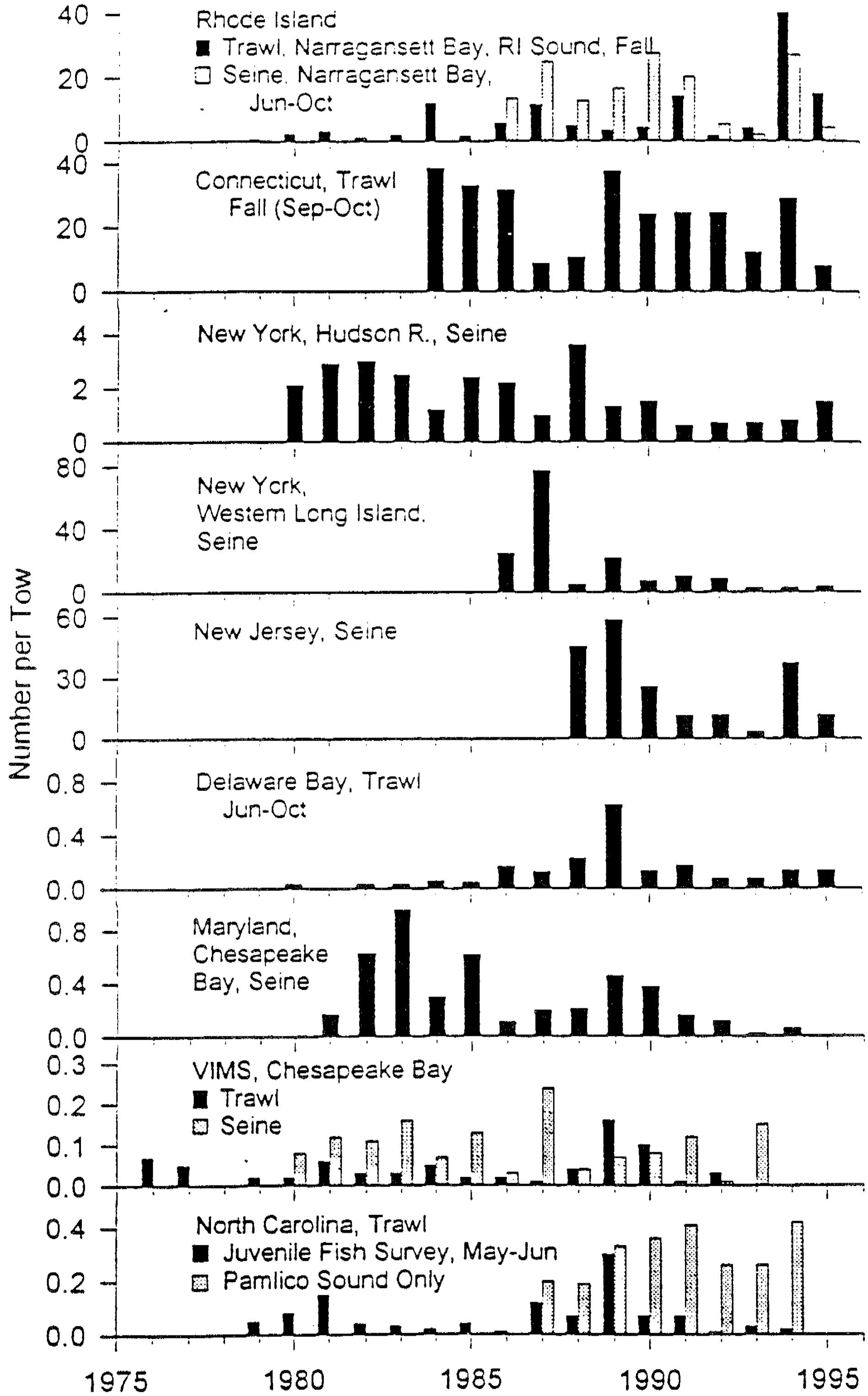

Figure 6. Annual collection of juveniles in various States' YOY surveys.
Source: Fahay 1998.

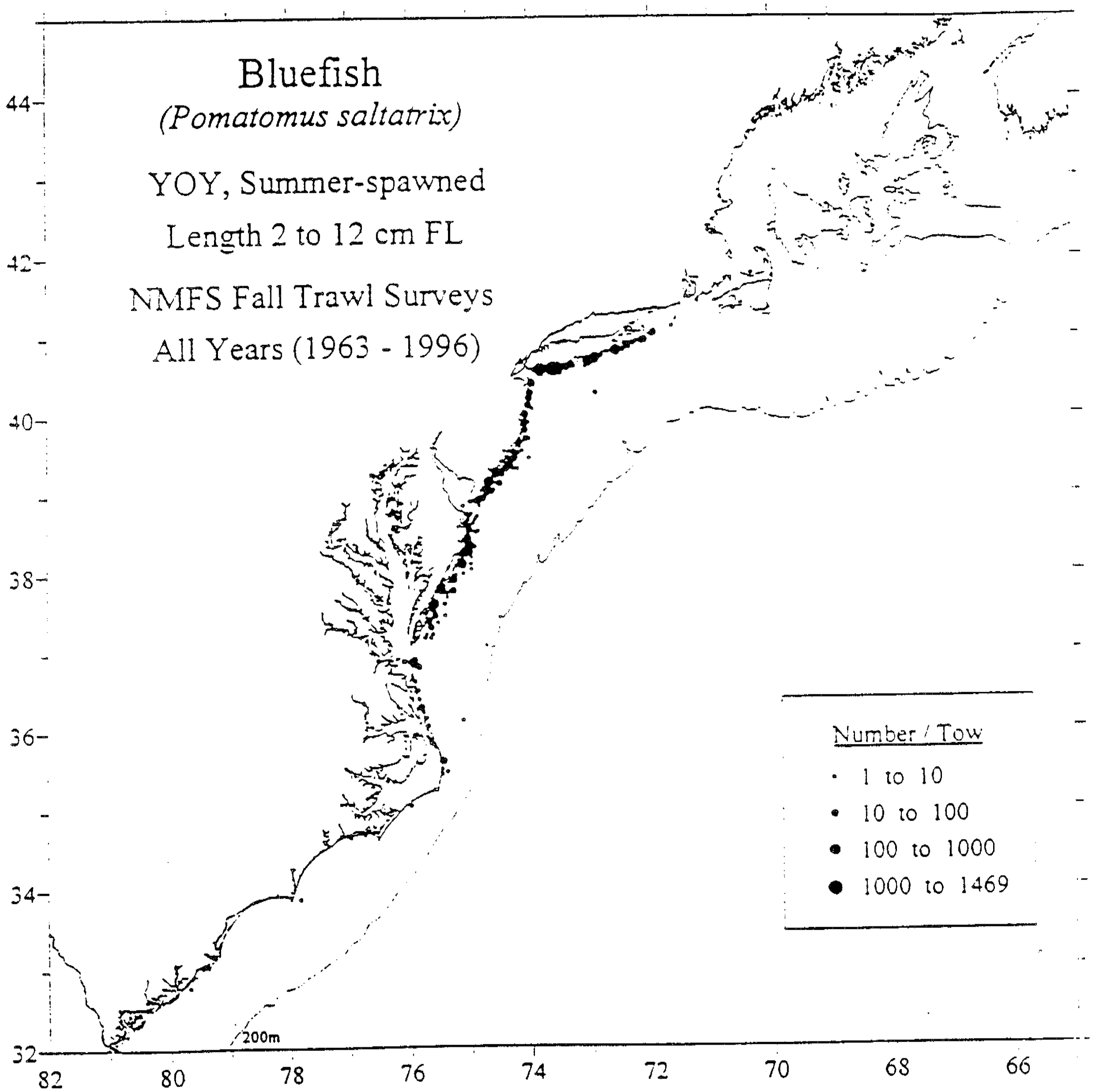

Figure 7. Distribution of summer-spawned YOY bluefish from NMFS fall trawl surveys (1963-1996). Source: Fahay 1998.

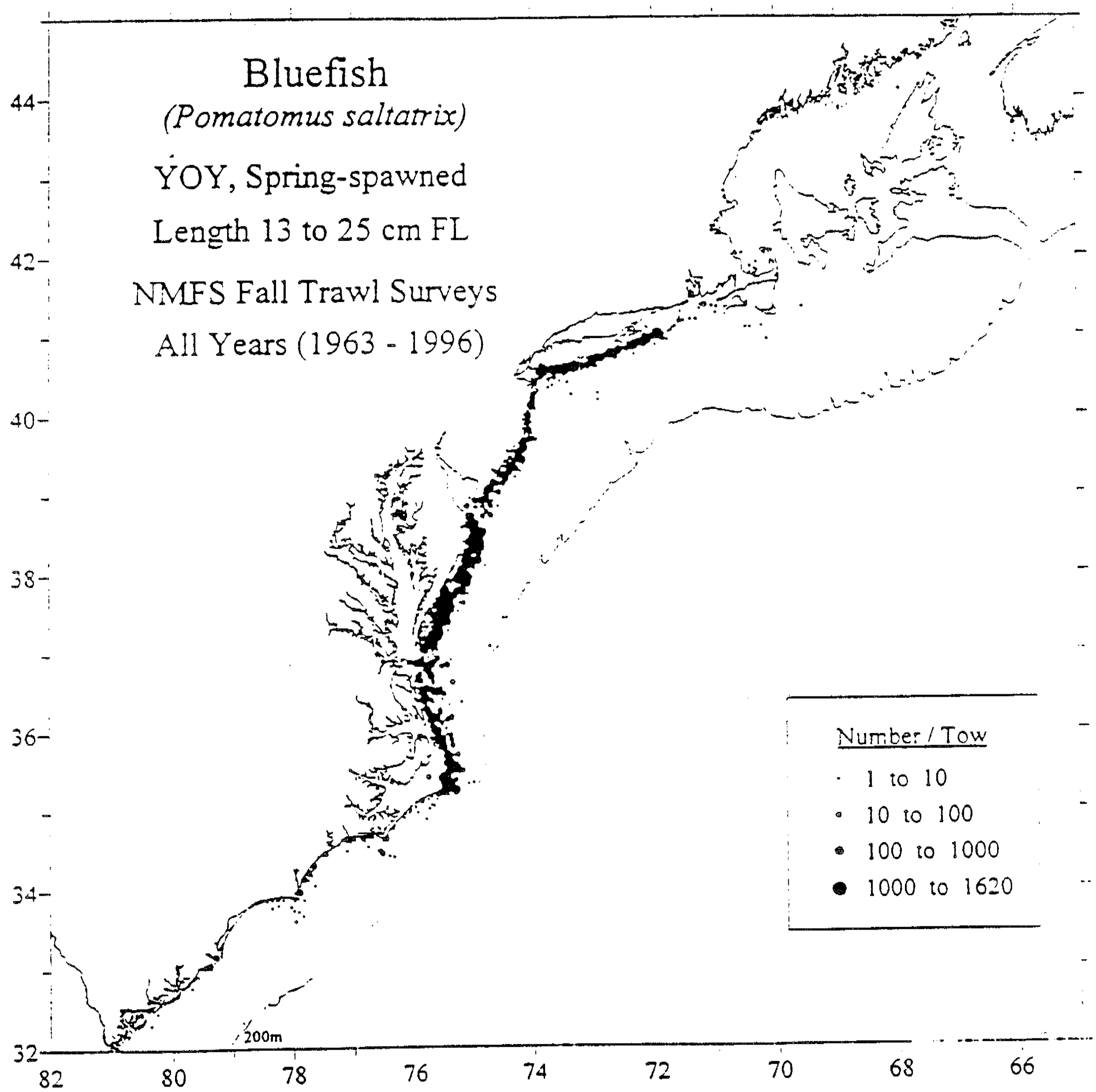

Figure 8. Distribution of spring-spawned YOY bluefish from NMFS fall trawl survey (1963-1996).
Source: Fahay 1998.

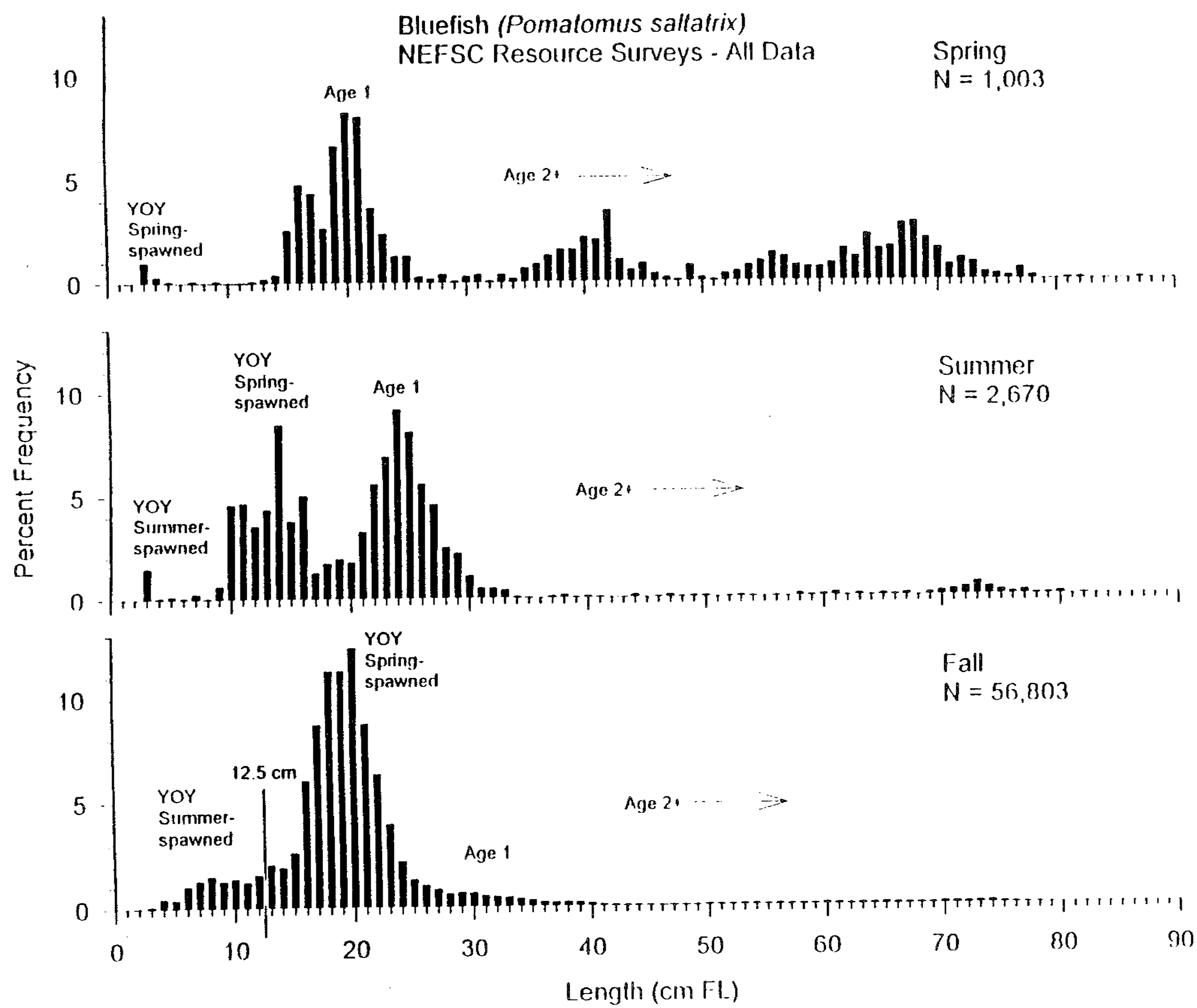

Figure 9. Length frequencies of bluefish from all NEFSC resource surveys.
Source: Fahay 1998.

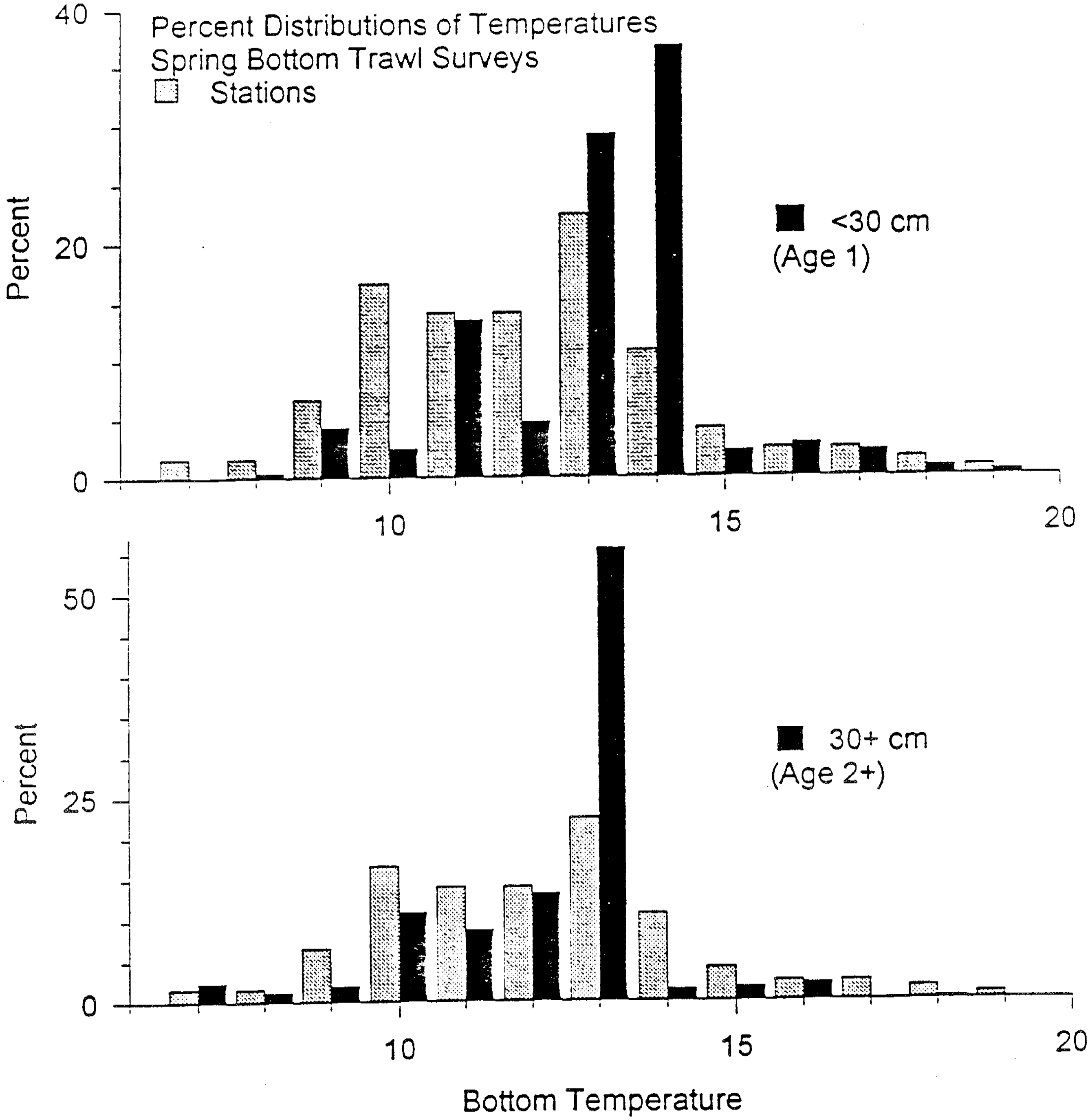

Figure 10. Percent distribution by temperatures of age 1 and 2+ bluefish from spring bottom trawl surveys. Source: Fahay 1998.

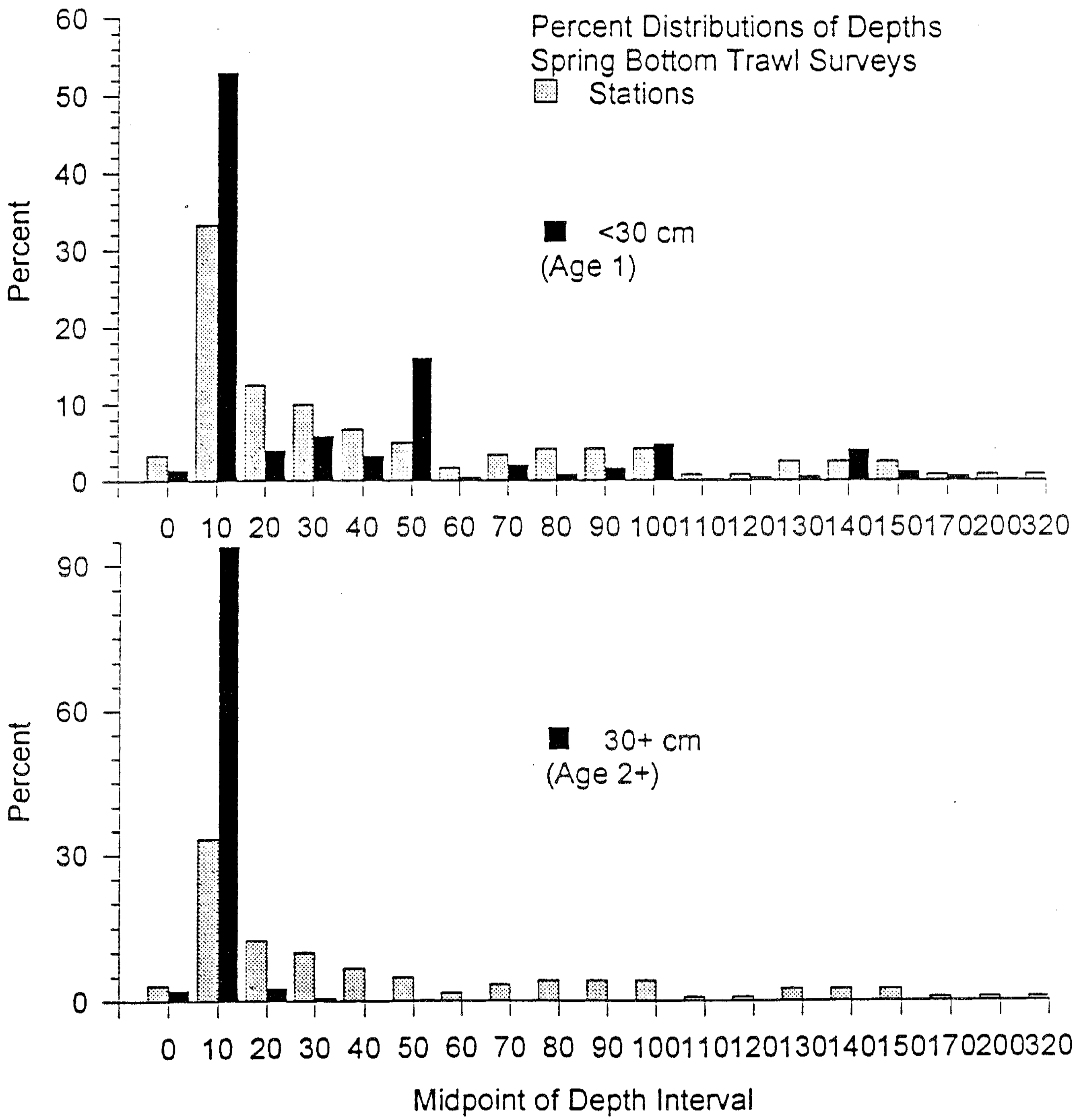

Figure 11. Percent distribution by depths of age 1 and age 2+ bluefish from spring bottom trawl surveys. Source: Fahay 1998.

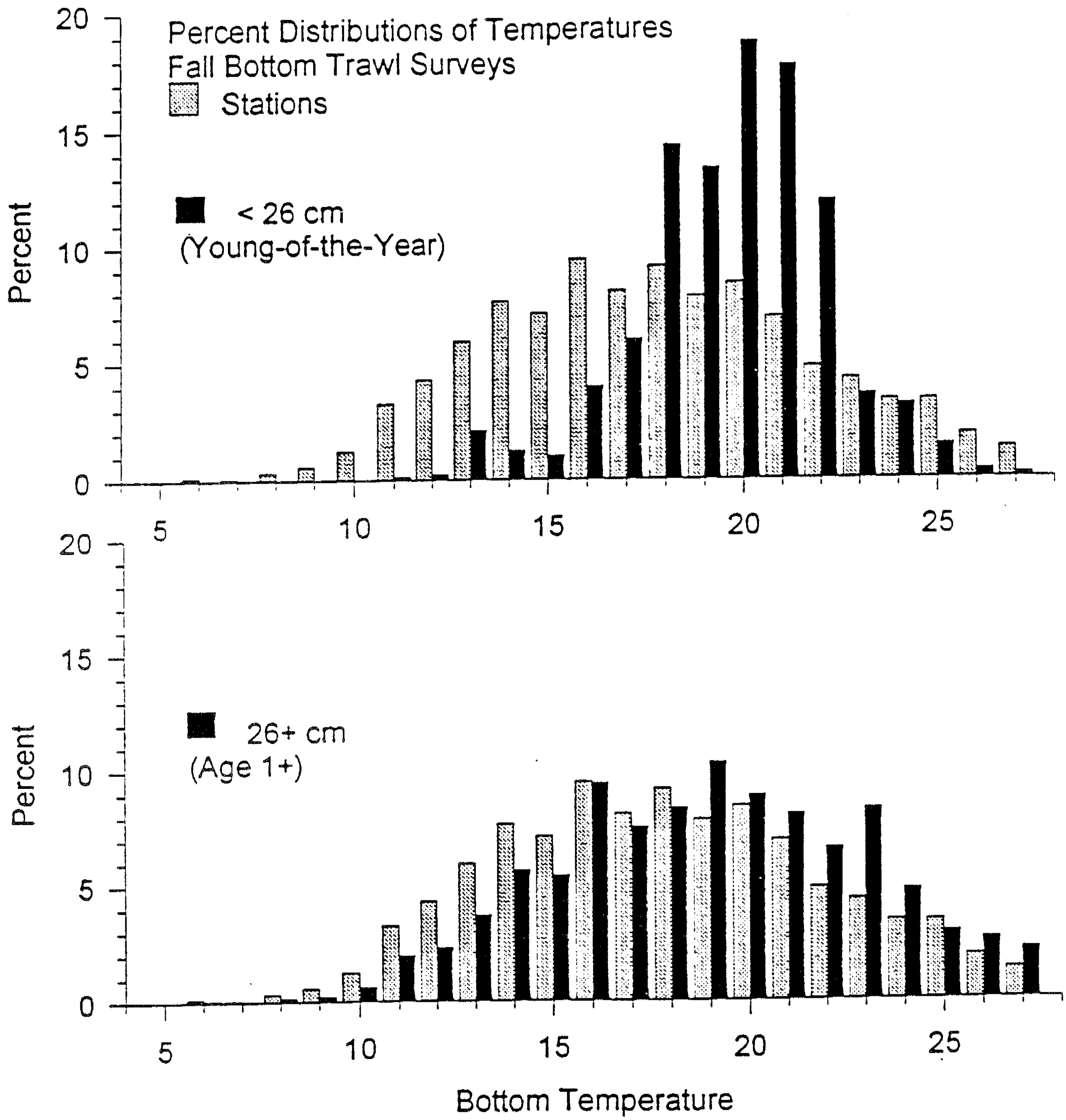

Figure 12. Percent distributions by temperatures of YOY and age 1+ bluefish from fall bottom trawl surveys. Source: Fahay 1998.

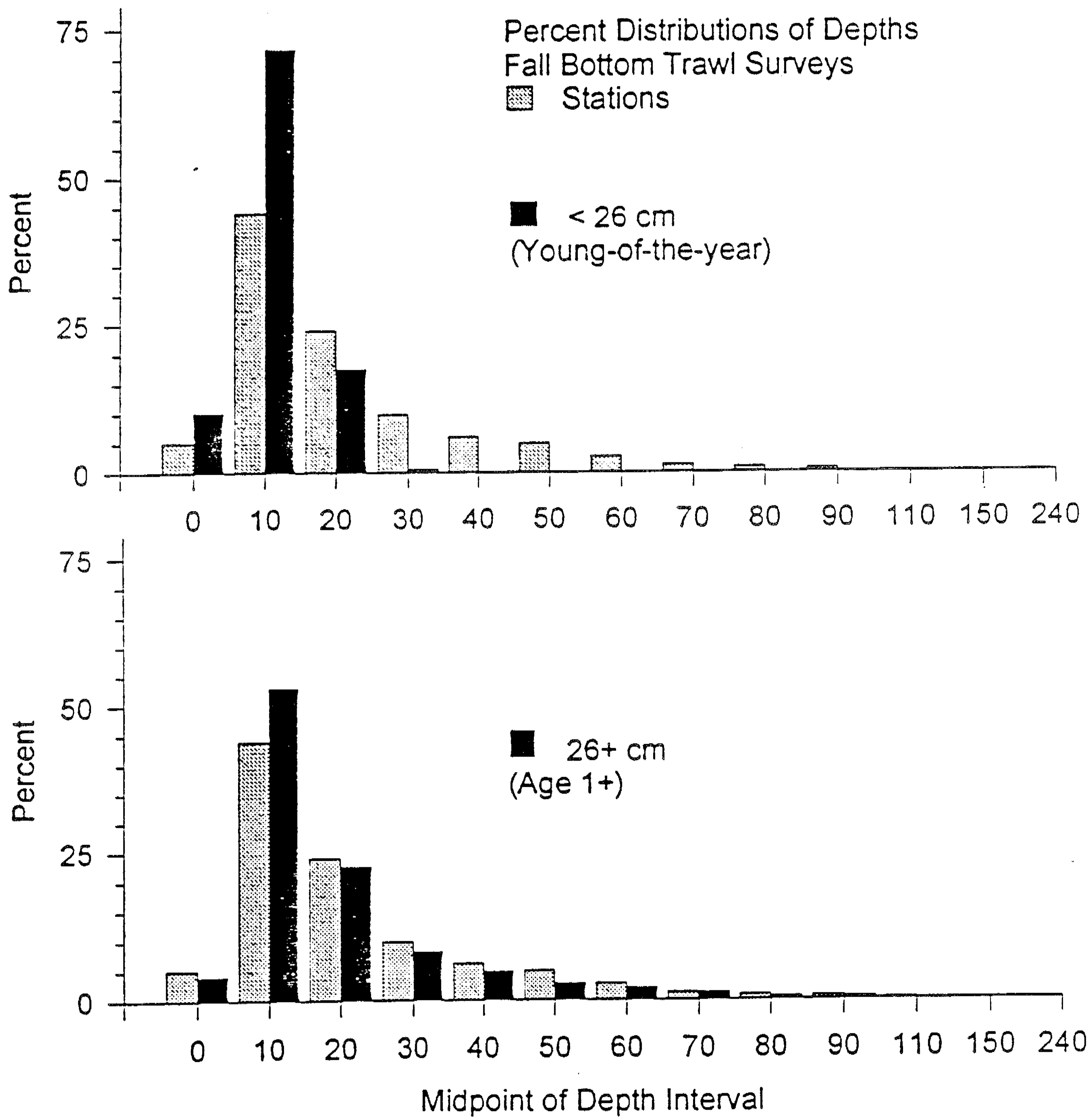

Figure 13. Percent distributions by depths of YOY and Age 1+ bluefish from fall bottom trawl surveys. Source: Fahay 1998.

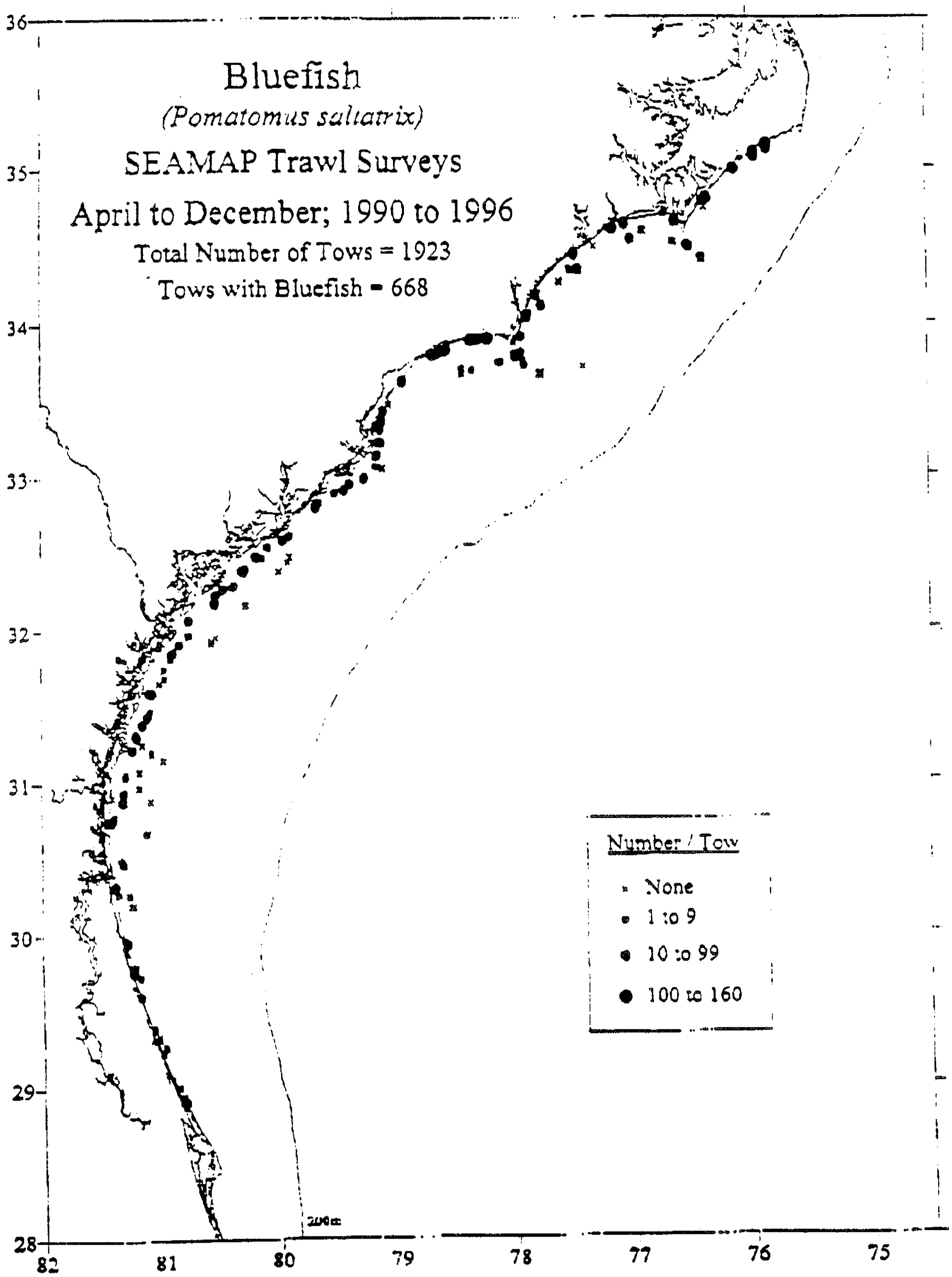

Figure 14. YOY bluefish collected in SEAMAP survey from 1990-1996.
Source: Fahay 1998.

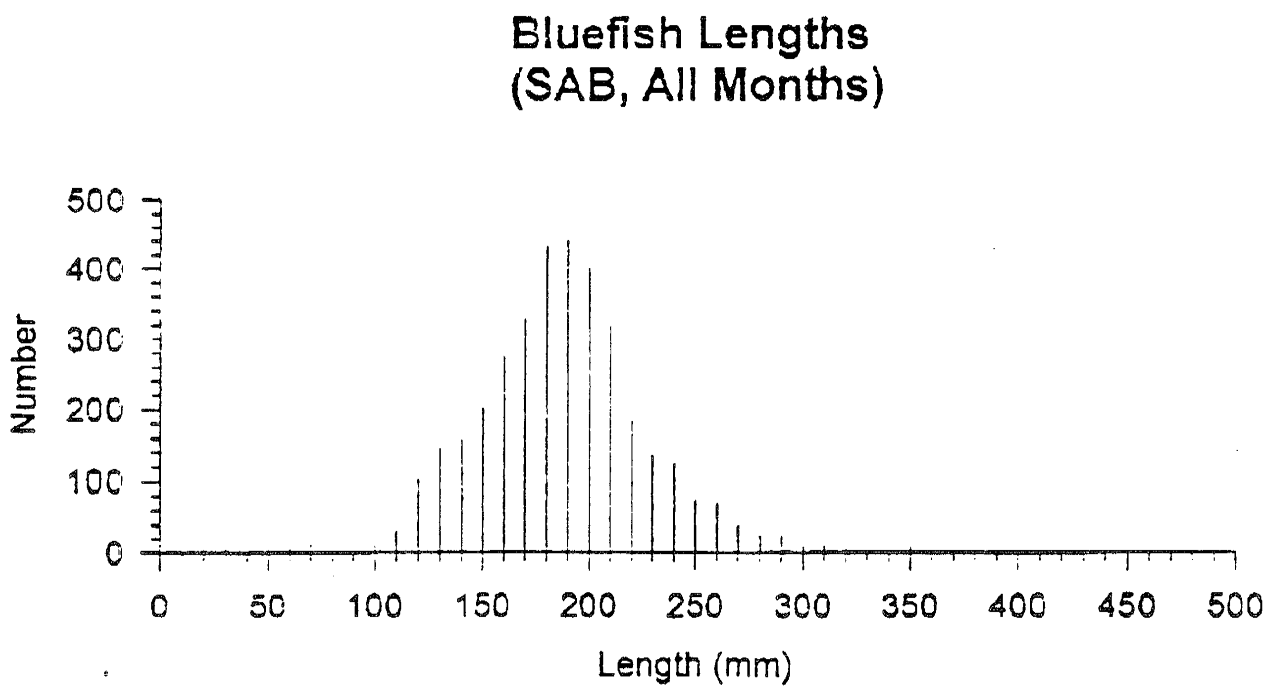

Figure 15. Length Frequency of bluefish collected in the SEAMAP survey from 1990-1996.
Source: Fahay 1998.

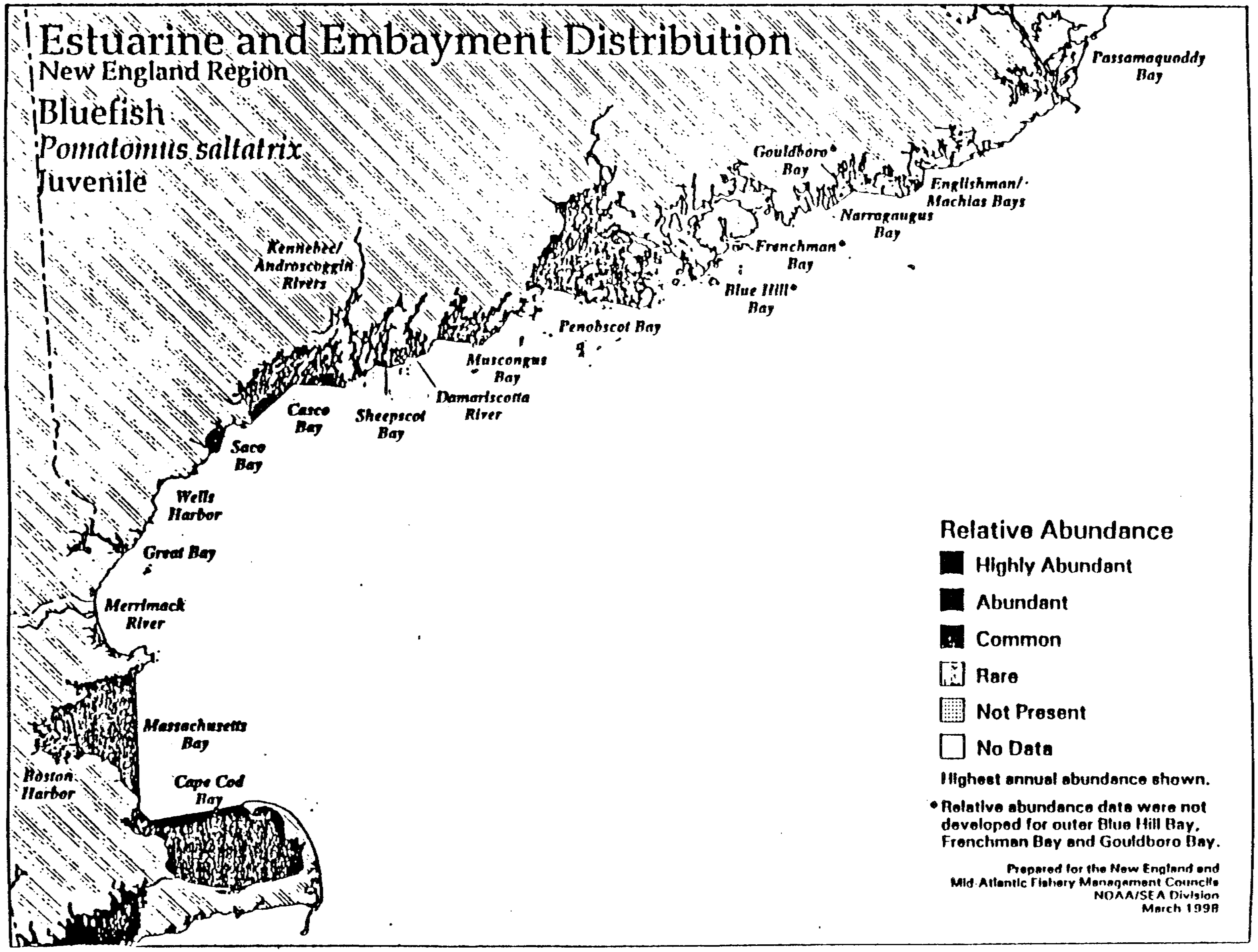

Figure 16. Relative abundance and distribution of juvenile bluefish in Atlantic coast estuaries. Those estuaries in which juvenile are classified as highly abundant , abundant , or common, excluding Waquoit Bay, MA and including Great Bay, NJ are designated as EFH.
Source: ELMR data.

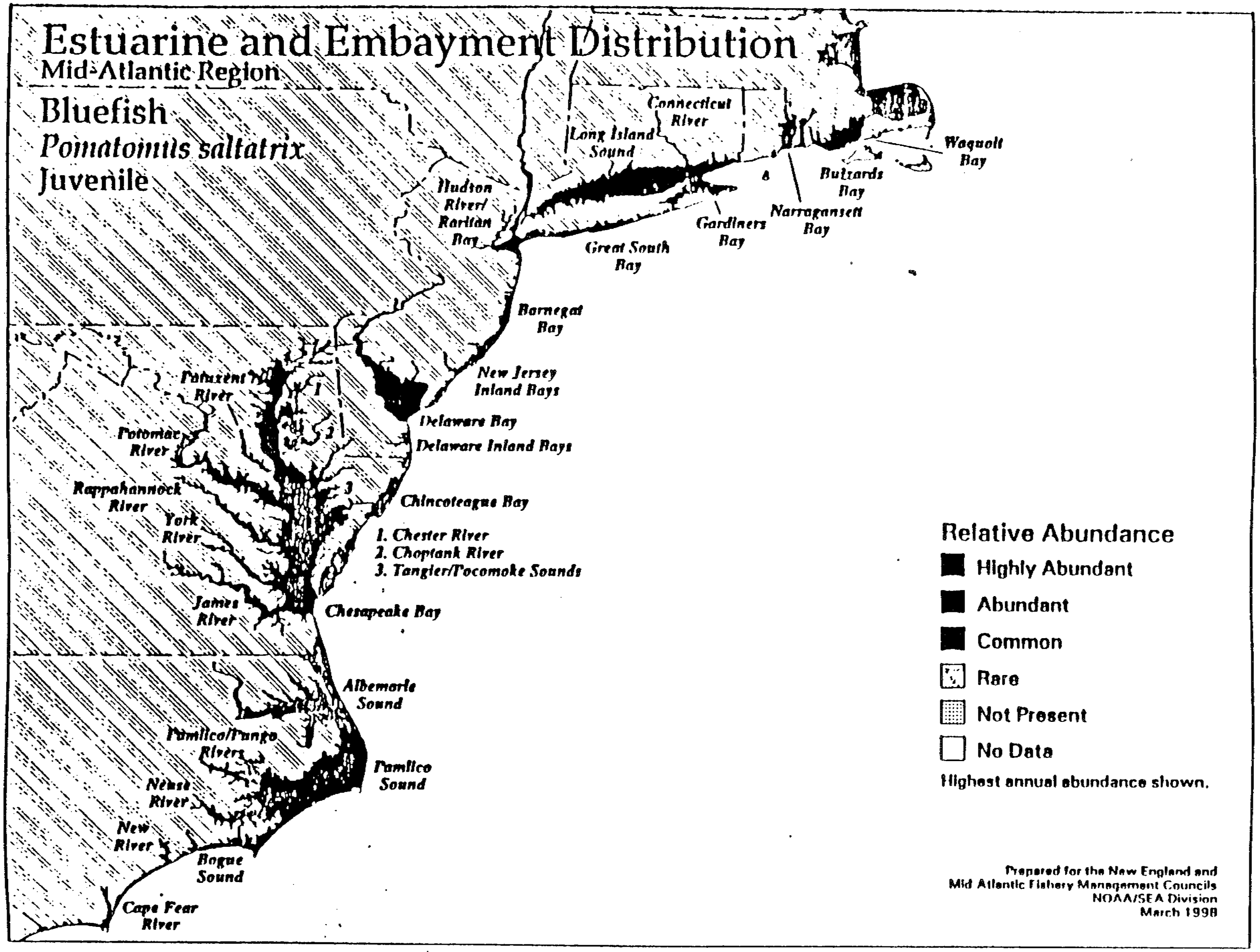

Figure 16 (continued). Relative abundance and distribution of juvenile bluefish in Atlantic coast estuaries. Those estuaries in which juvenile are classified as highly abundant , abundant , or common, excluding Waquoit Bay, MA and including Great Bay, NJ are designated as EFH. Source: ELMR data.

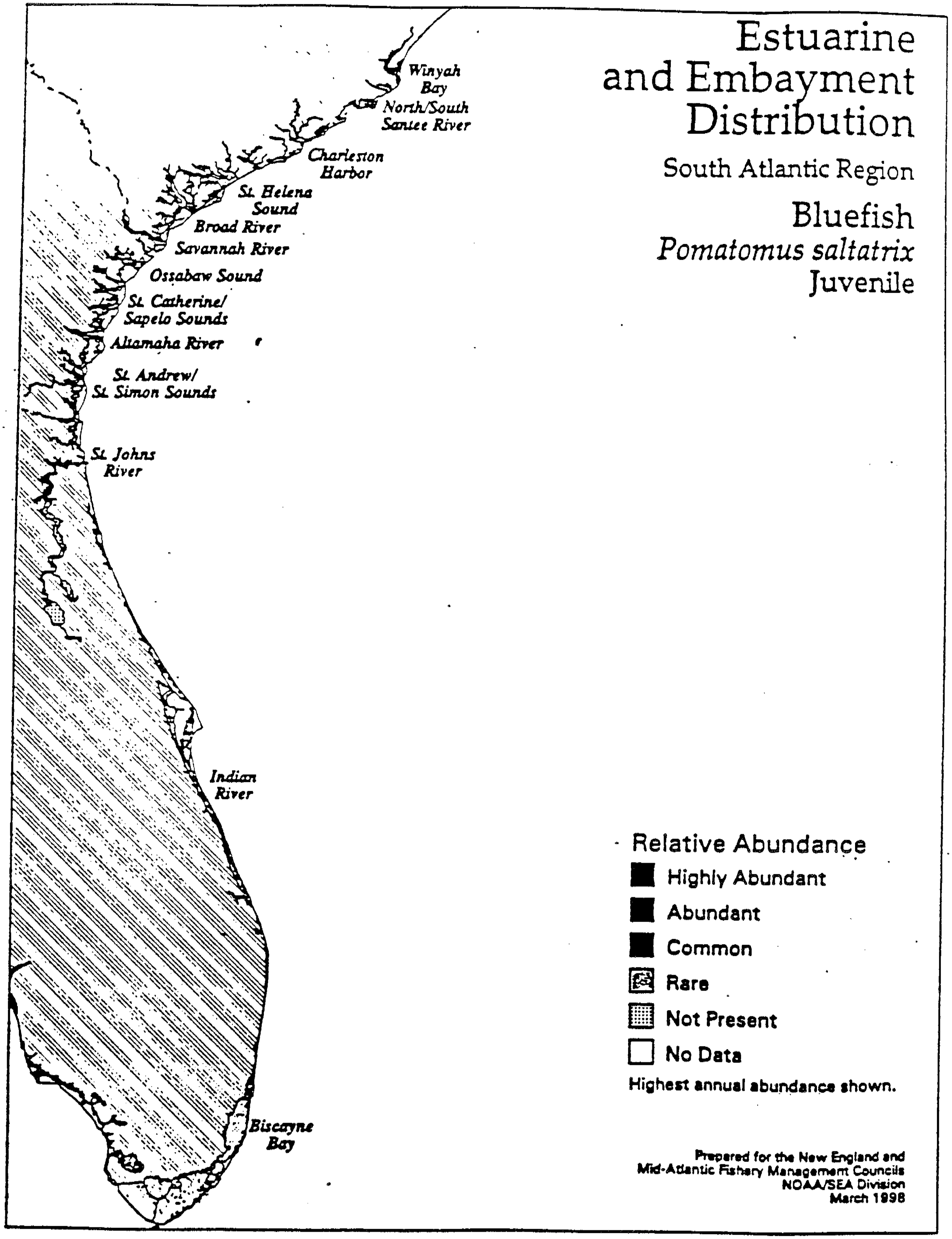

Figure 16 (continued). Relative abundance and distribution of juvenile bluefish in Atlantic coast estuaries. Those estuaries in which juvenile are classified as highly abundant , abundant , or common, excluding Waquoit Bay, MA and including Great Bay, NJ are designated as EFH.
Source: ELMR data.

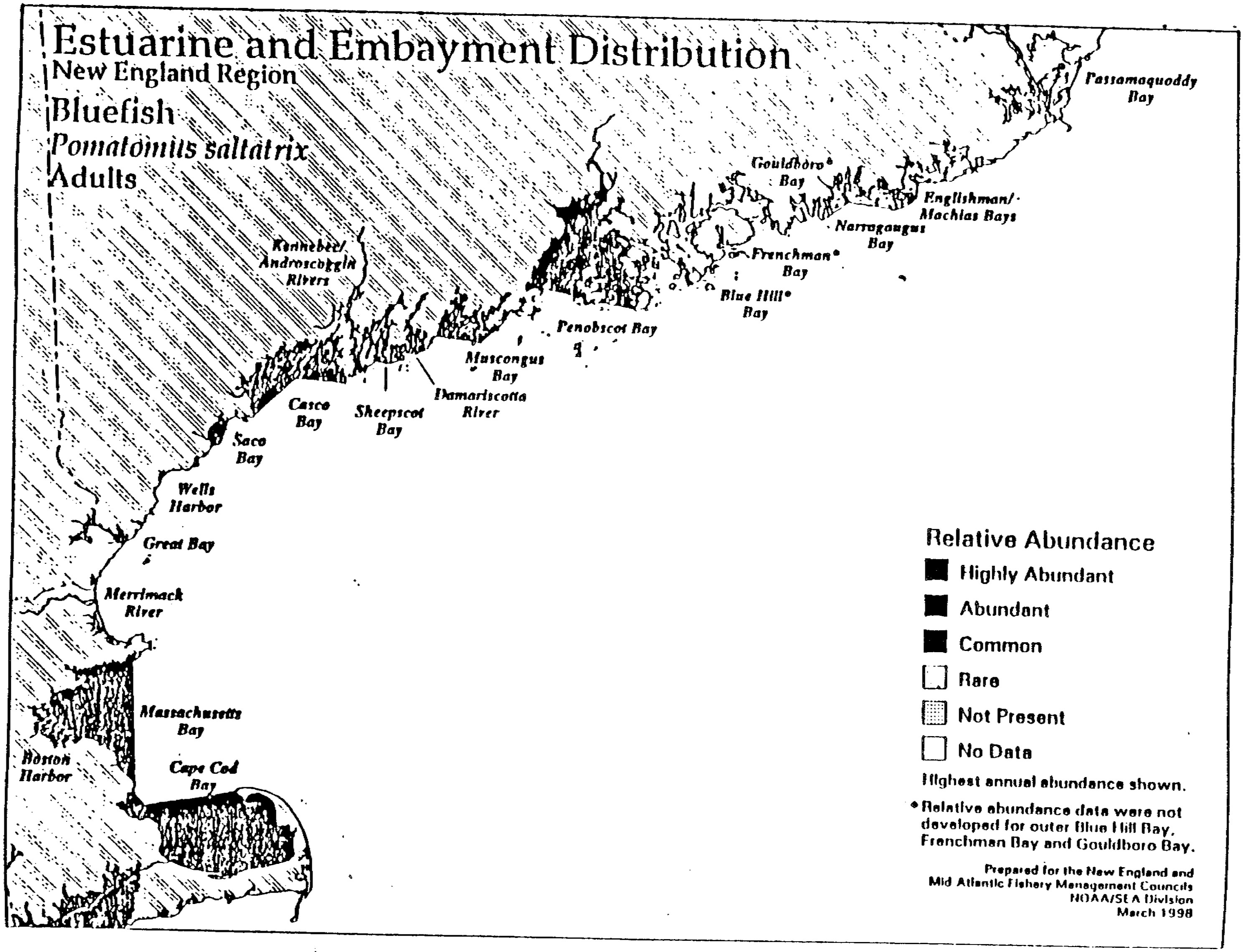

Figure 17. Relative abundance and distribution of adult bluefish in Atlantic coast estuaries. Those estuaries in which adults are classified as highly abundant , abundant , or common are designated as EFH.
Source: ELMR data.

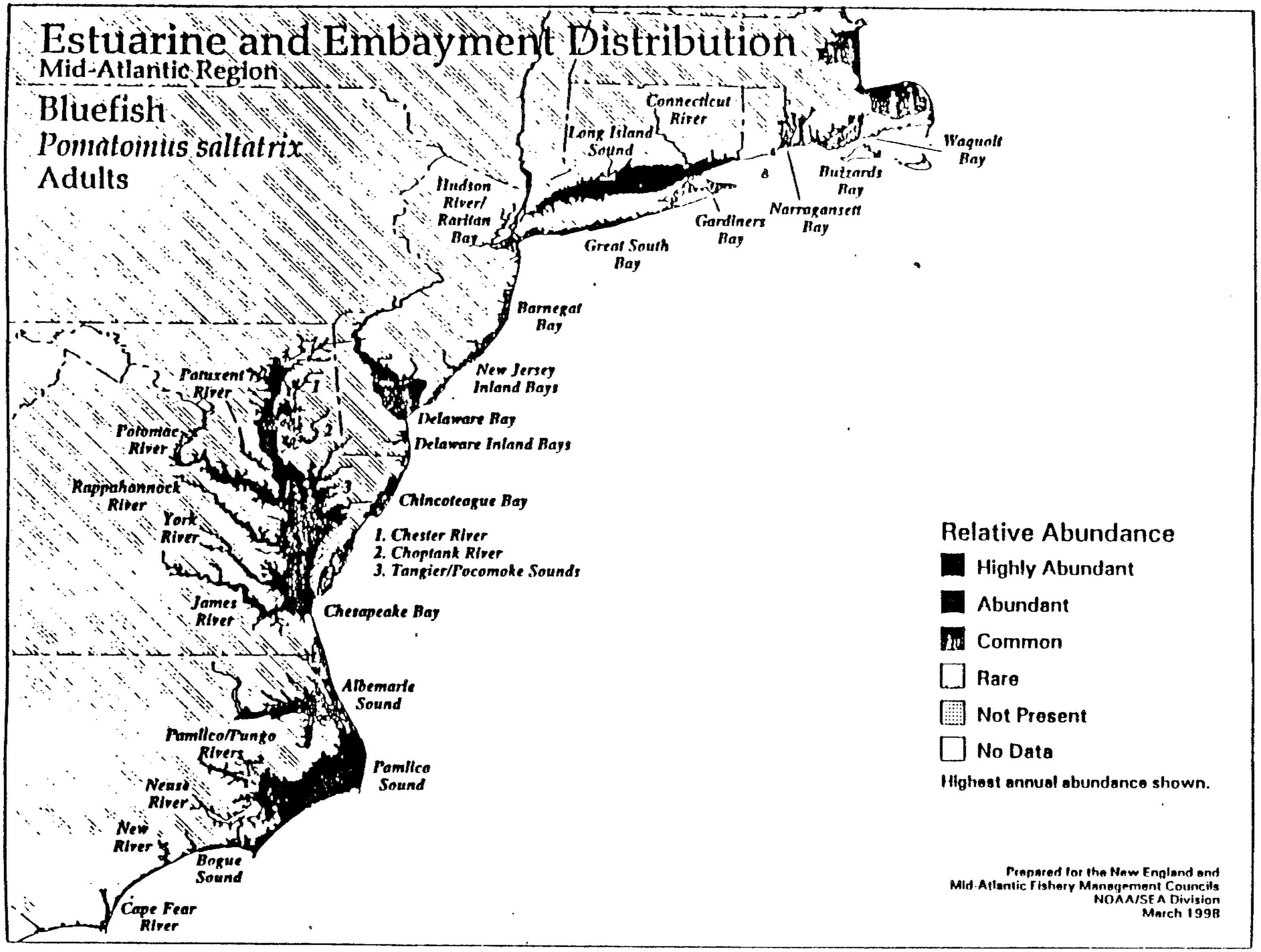

Figure 17 (continued). Relative abundance and distribution of adult bluefish in Atlantic coast estuaries. Those estuaries in which adults are classified as highly abundant , abundant , or common are designated as EFH.
Source: ELMR data.

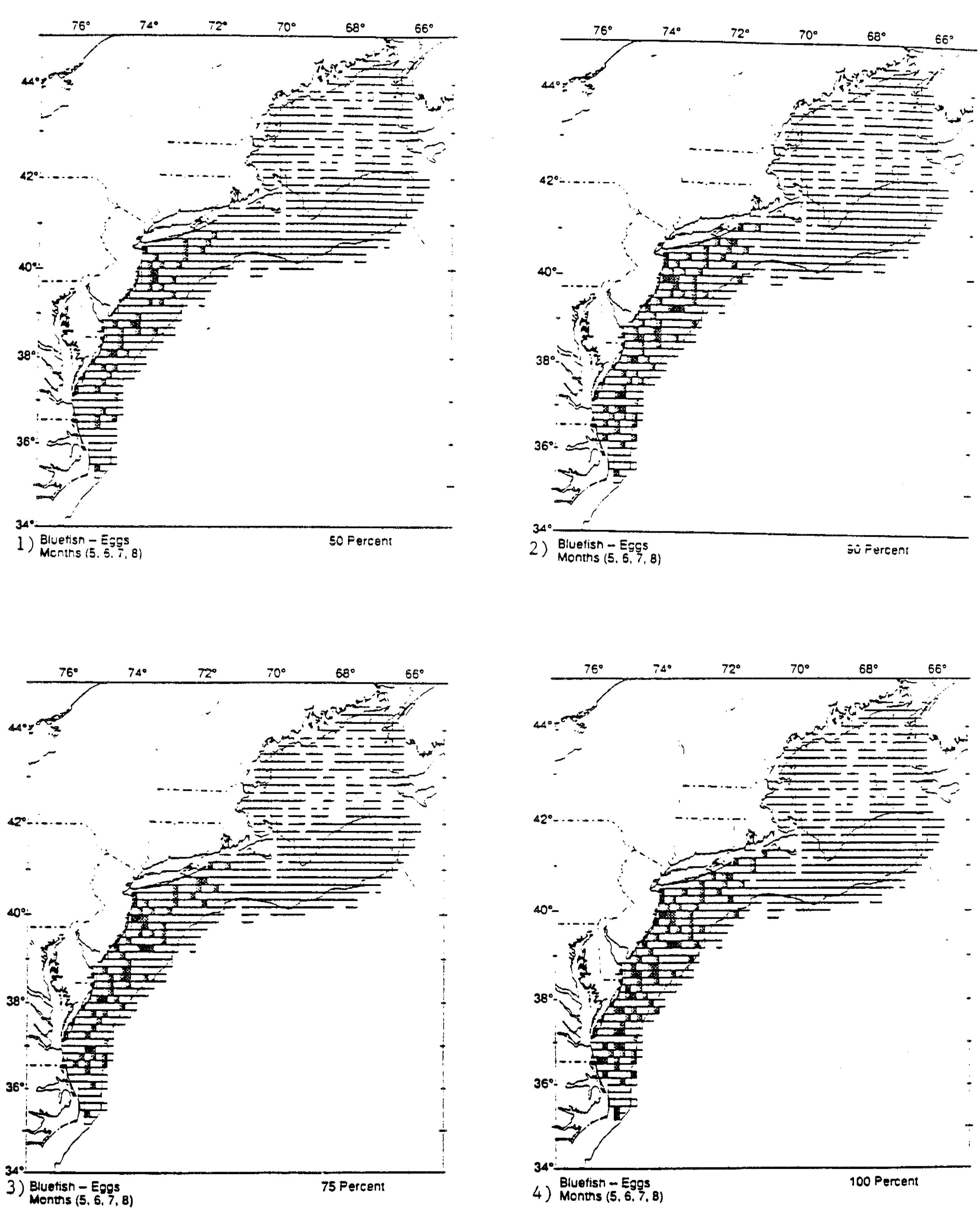

Figure 18. Four options for designating EFH for bluefish eggs under Alternative 5, the preferred alternative: 1) the top 50% of the area, 2) the top 75% of the area, 3) the op 90%, and 100% of the area where bluefish eggs were found in the MARMAP survey.

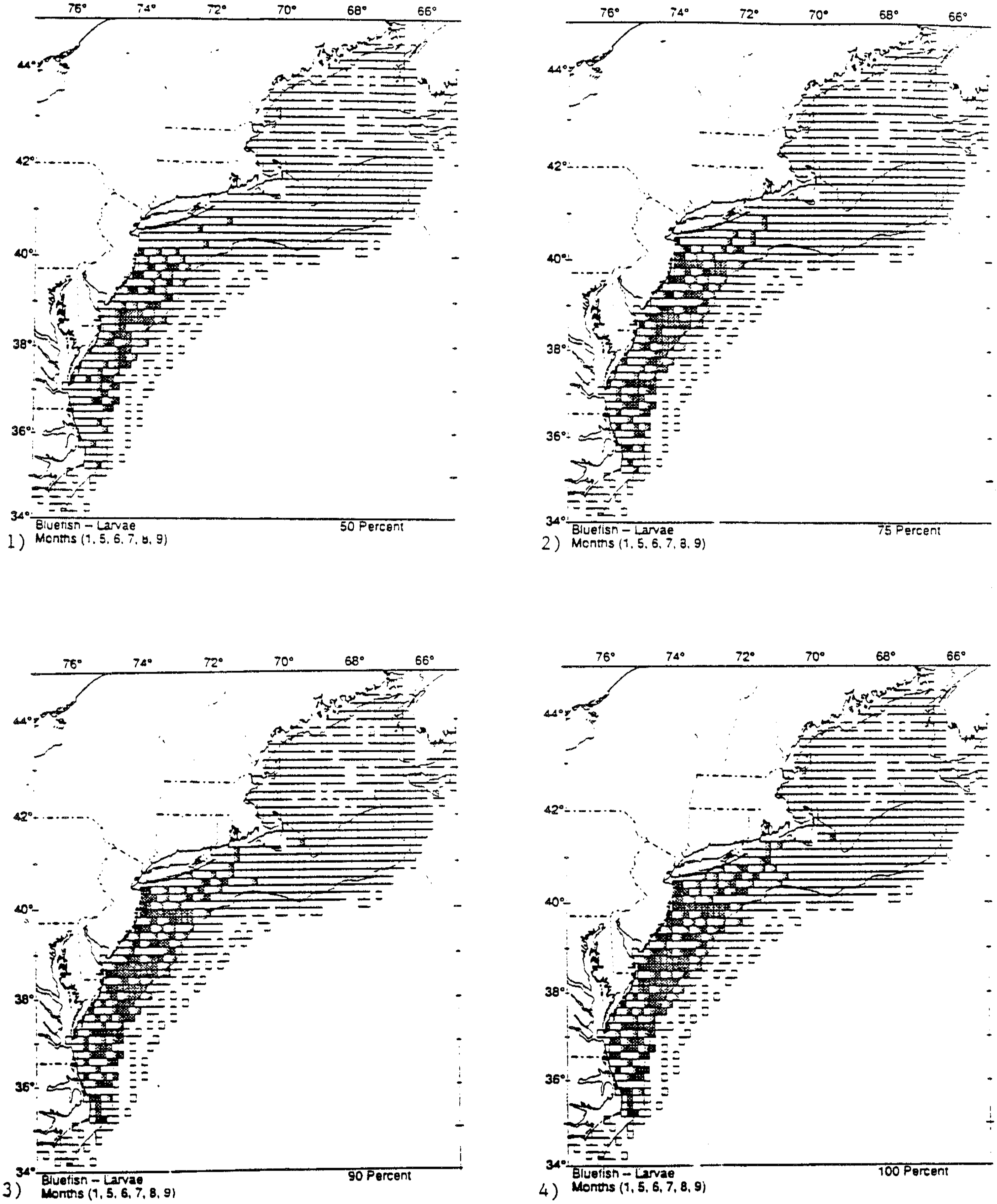

Figure 19. Four options for designating EFH for bluefish larvae under Alternative 5, the preferred alternative: 1) the top 50% of the area, 2) the top 75% of the area, 3) the op 90%, and 100% of the area where bluefish larvae were found in the MARMAP survey.

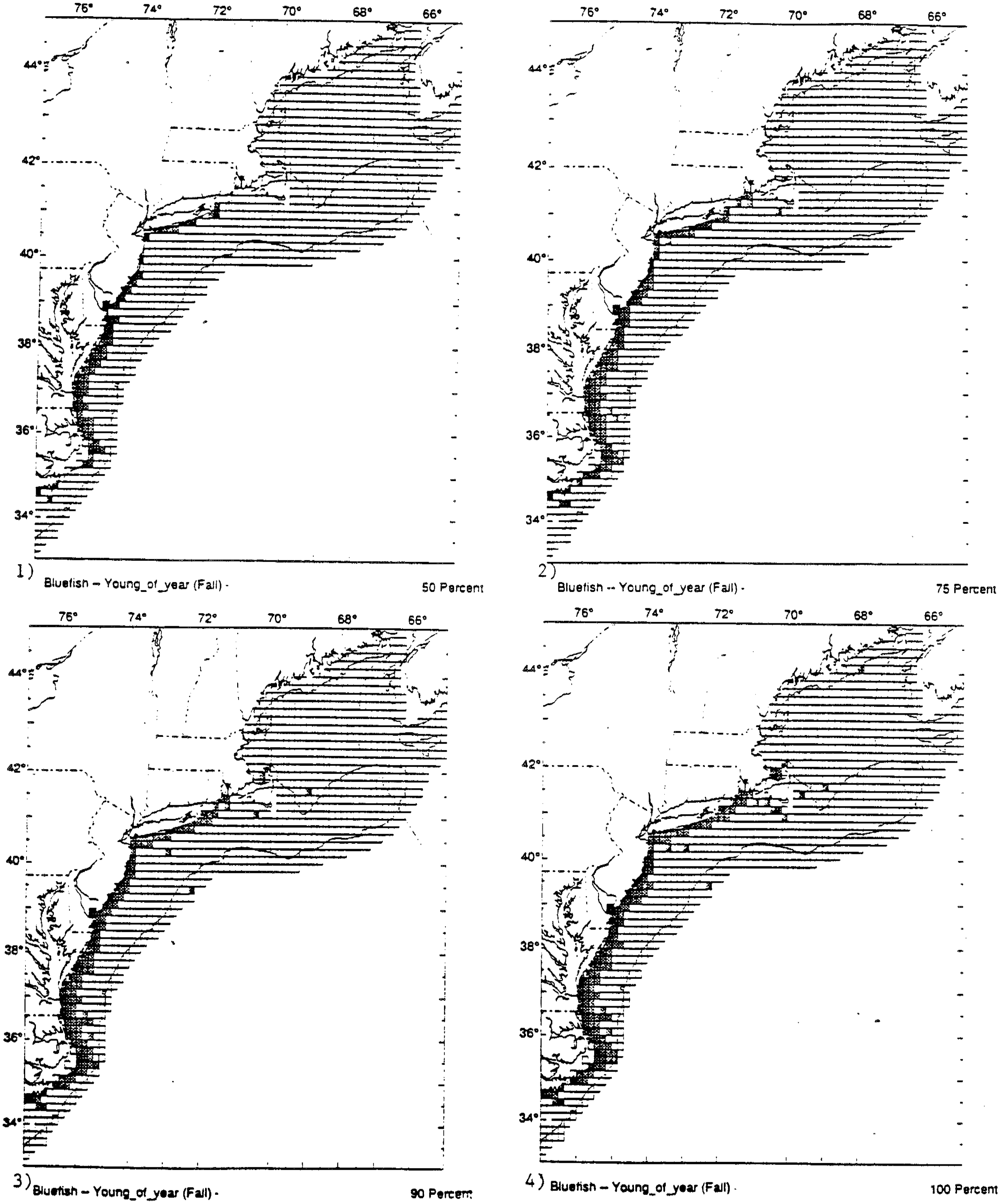

Figure 20. Four options for designating EFH for juvenile bluefish under Alternative 5, the preferred alternative: 1) the top 50% of the area, 2) the top 75% of the area, 3) the op 90%, and 100% of the area where juvenile bluefish were found in the NEFSC trawl survey.

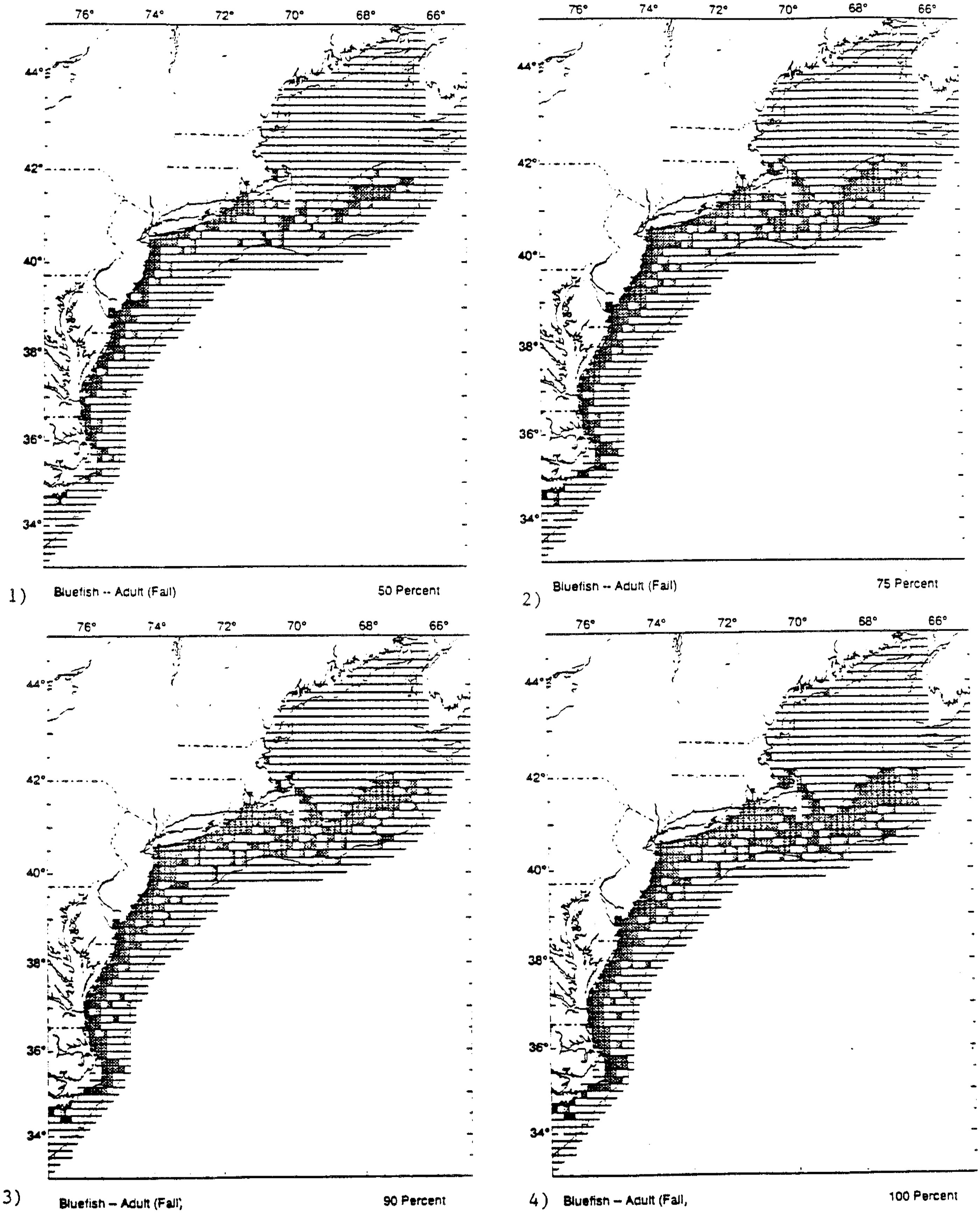

Figure 21. Four options for designating EFH for adult bluefish under Alternative 5, the preferred alternative: 1) the top 50% of the area, 2) the top 75% of the area, 3) the op 90%, and 100% of the area where adult bluefish were found in the NEFSC trawl survey.

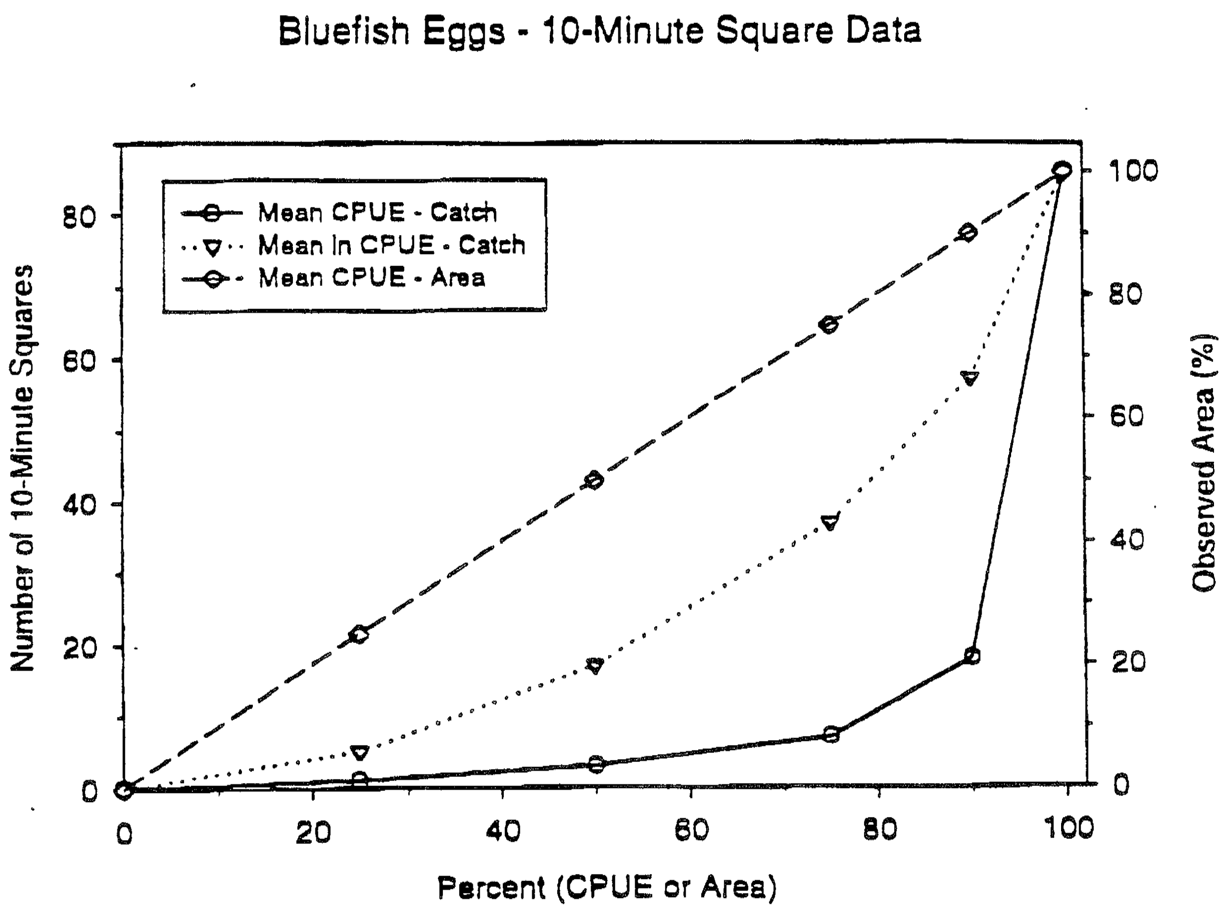

Figure 22a. Graphical representation of percent area and numbers of 10 minute squares encompassed in the a) area analysis, b) logged CPUE analysis, and c) CPUE of bluefish eggs.
Source: Cross pers. comm.

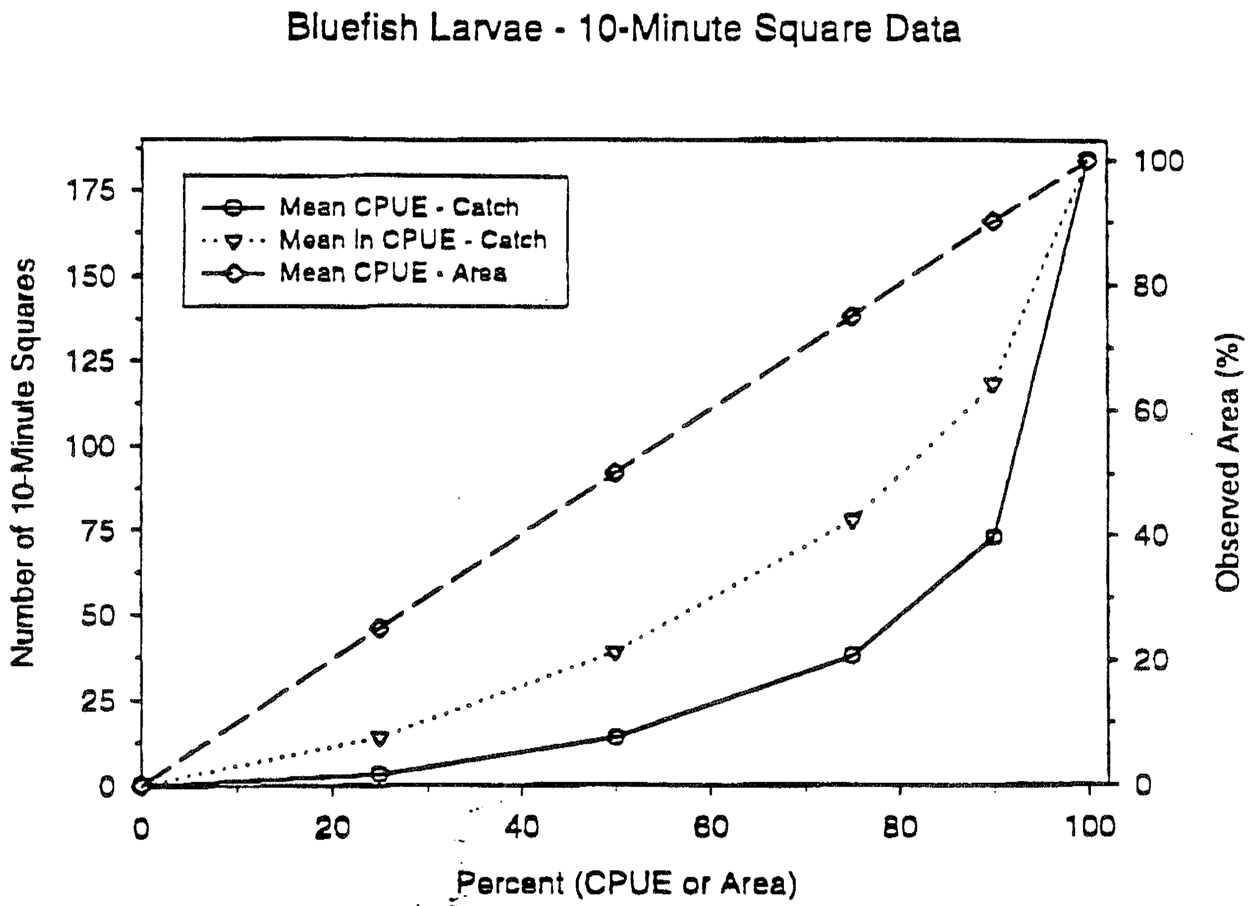

Figure 22b. Graphical representation of percent area and numbers of 10 minute squares encompassed in the a) area analysis, b) logged CPUE analysis, and c) CPUE of bluefish larvae.
Source: Cross pers. comm.

Bluefish Juveniles (Fall) - 10-Minute Square Data

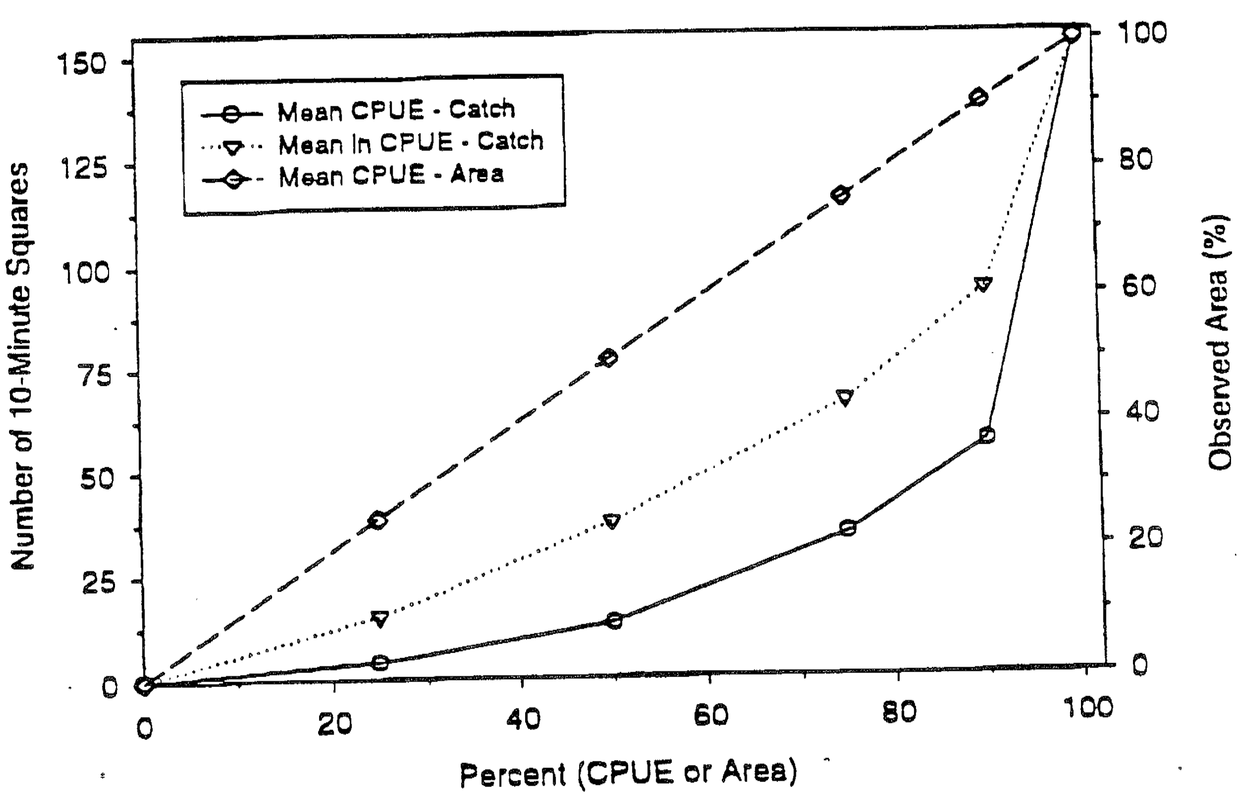

Figure 22c. Graphical representation of percent area and numbers of 10 minute squares encompassed in the a) area analysis, b) logged CPUE analysis, and c) CPUE of juvenile bluefish.
Source: Cross pers. comm.

Bluefish Adults (Fall) - 10-Minute Square Data

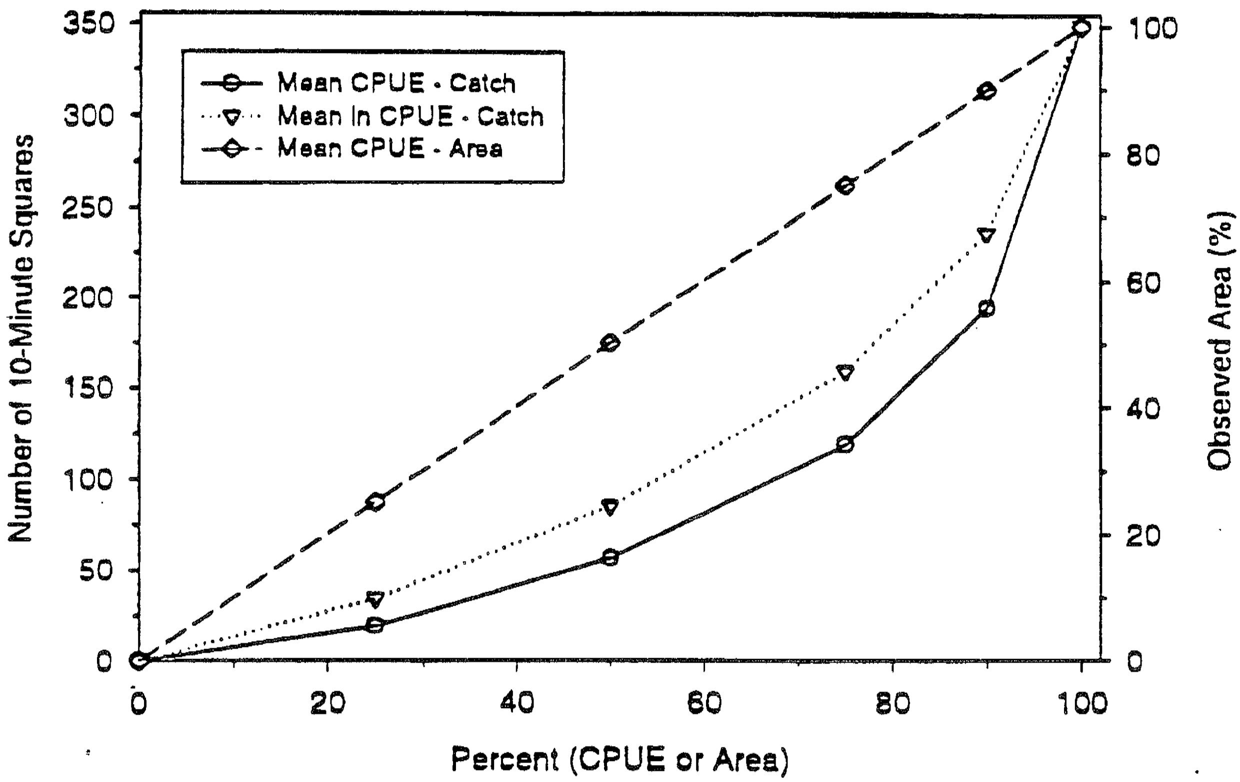

Figure 22d. Graphical representation of percent area and numbers of 10 minute squares encompassed in the a) area analysis, b) logged CPUE analysis, and c) CPUE of adult bluefish.
Source: Cross pers. comm.

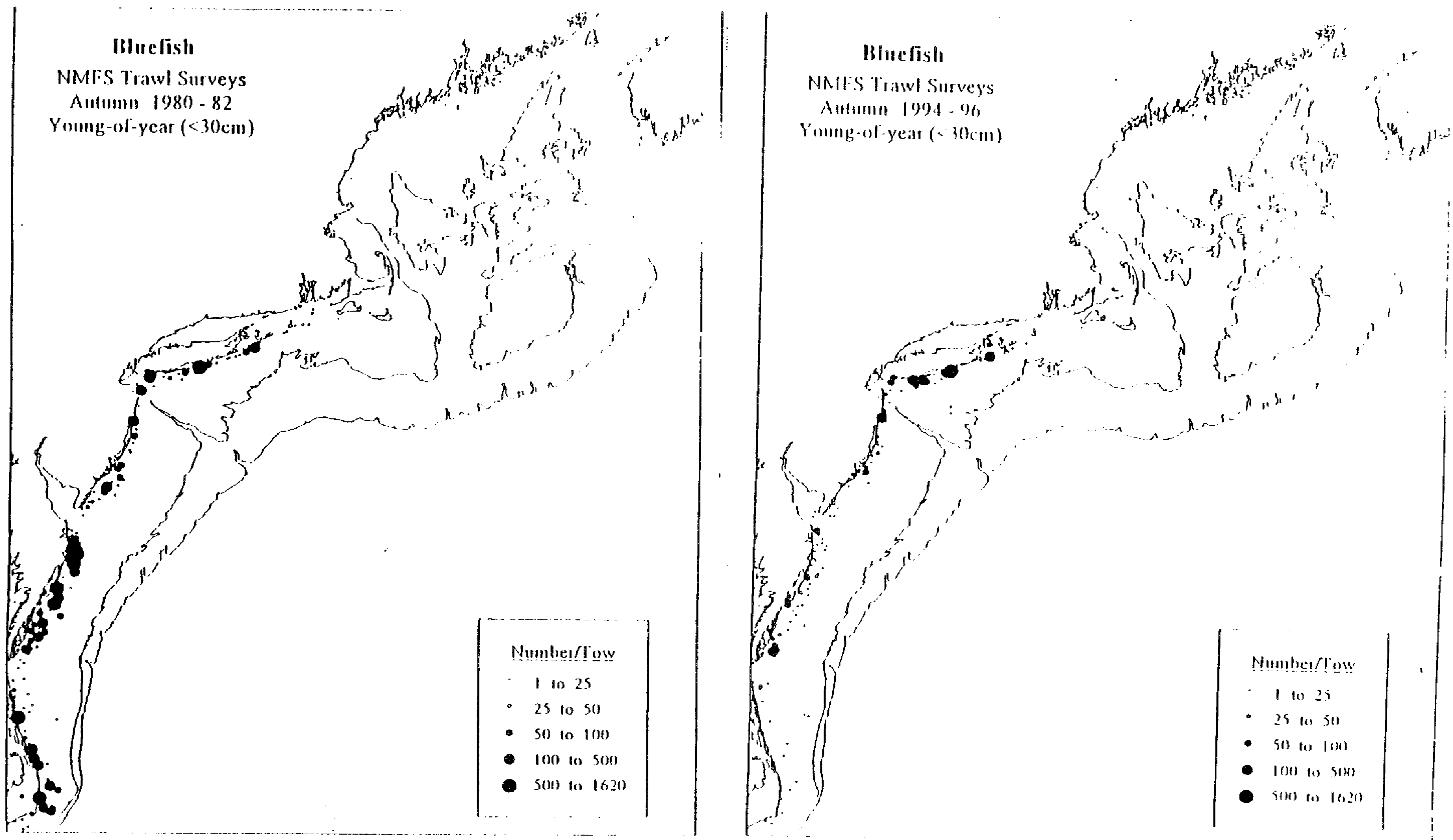

Figure 23. Distribution of Bluefish YOY in the NEFSC autumn trawl survey (number per tow) in periods of high abundance (1980-1982) and periods of low abundance (1994-1996).
Source: Fahay 1998.

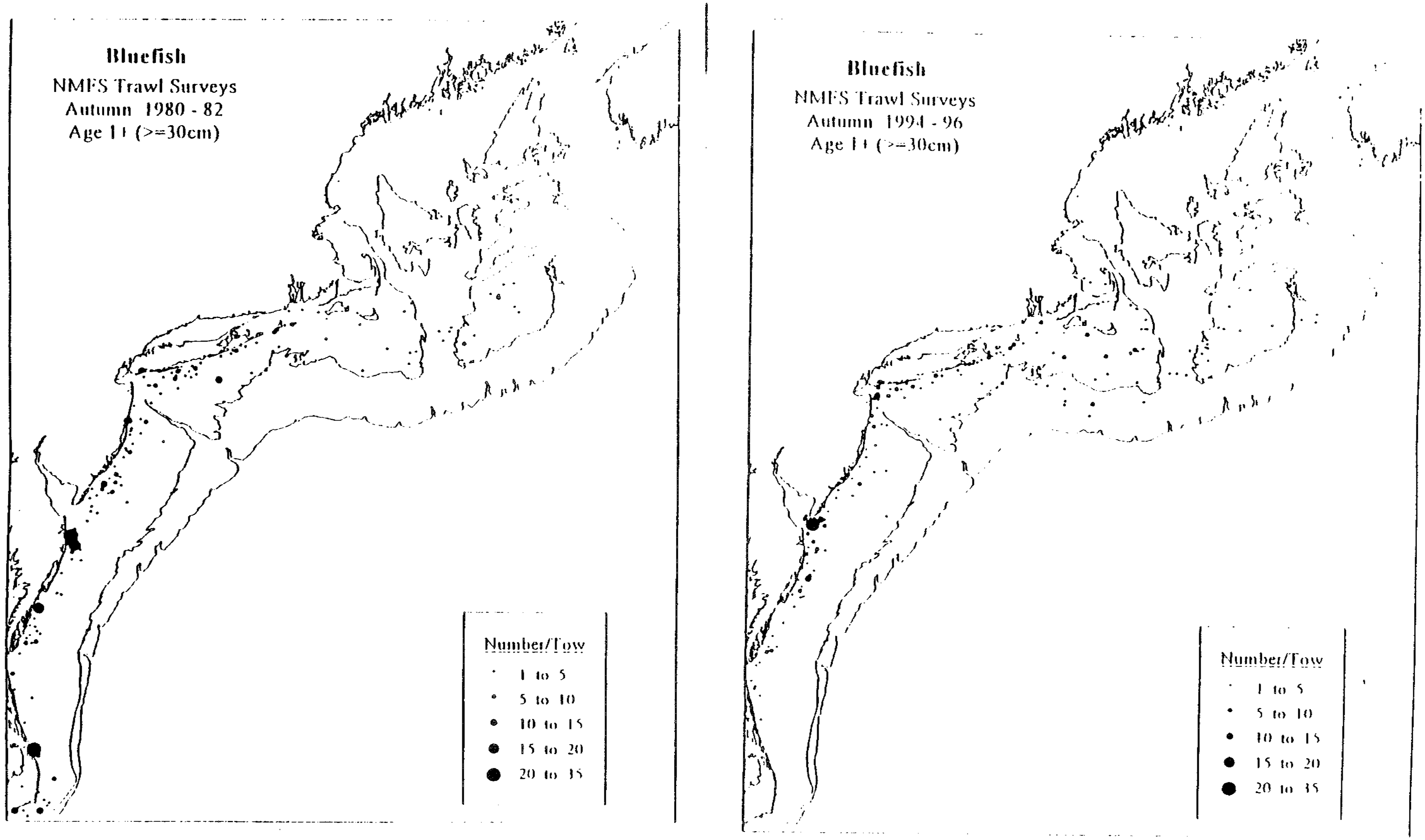

Figure 24. Distribution of bluefish adults in the NEFSC autumn trawl survey (number per tow) in periods of high abundance (1980-1982) and periods of low abundance (1994-1996).
Source: Fahay 1998.

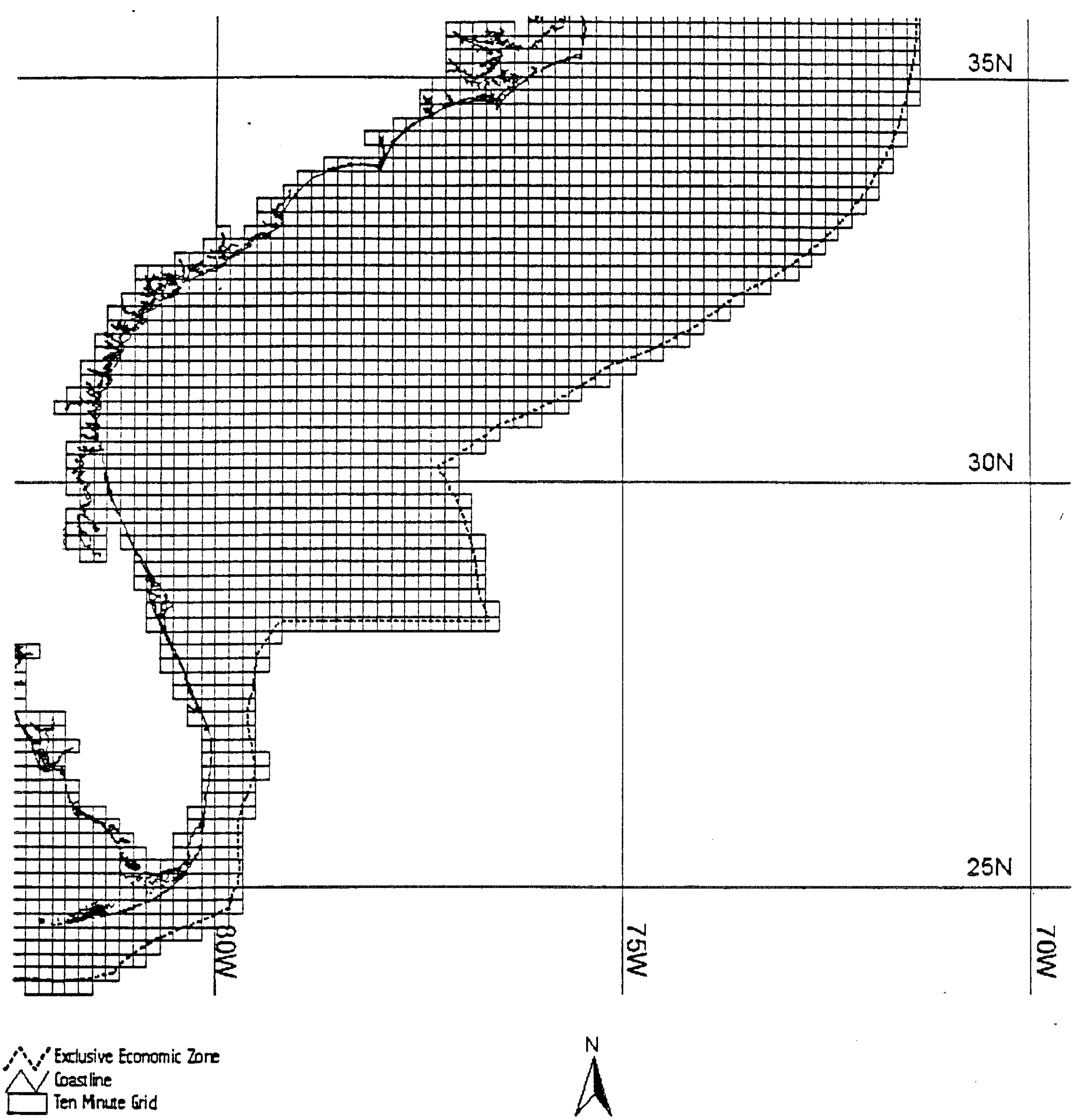

Figure 25. EFH for bluefish of all life stages south of Cape Hatteras, 100% of the pelagic waters over the Continental Shelf (from the coast to the eastern wall of the Gulf Stream) through Key West, FL at mid-shelf depths. Source: Cross pers. com.

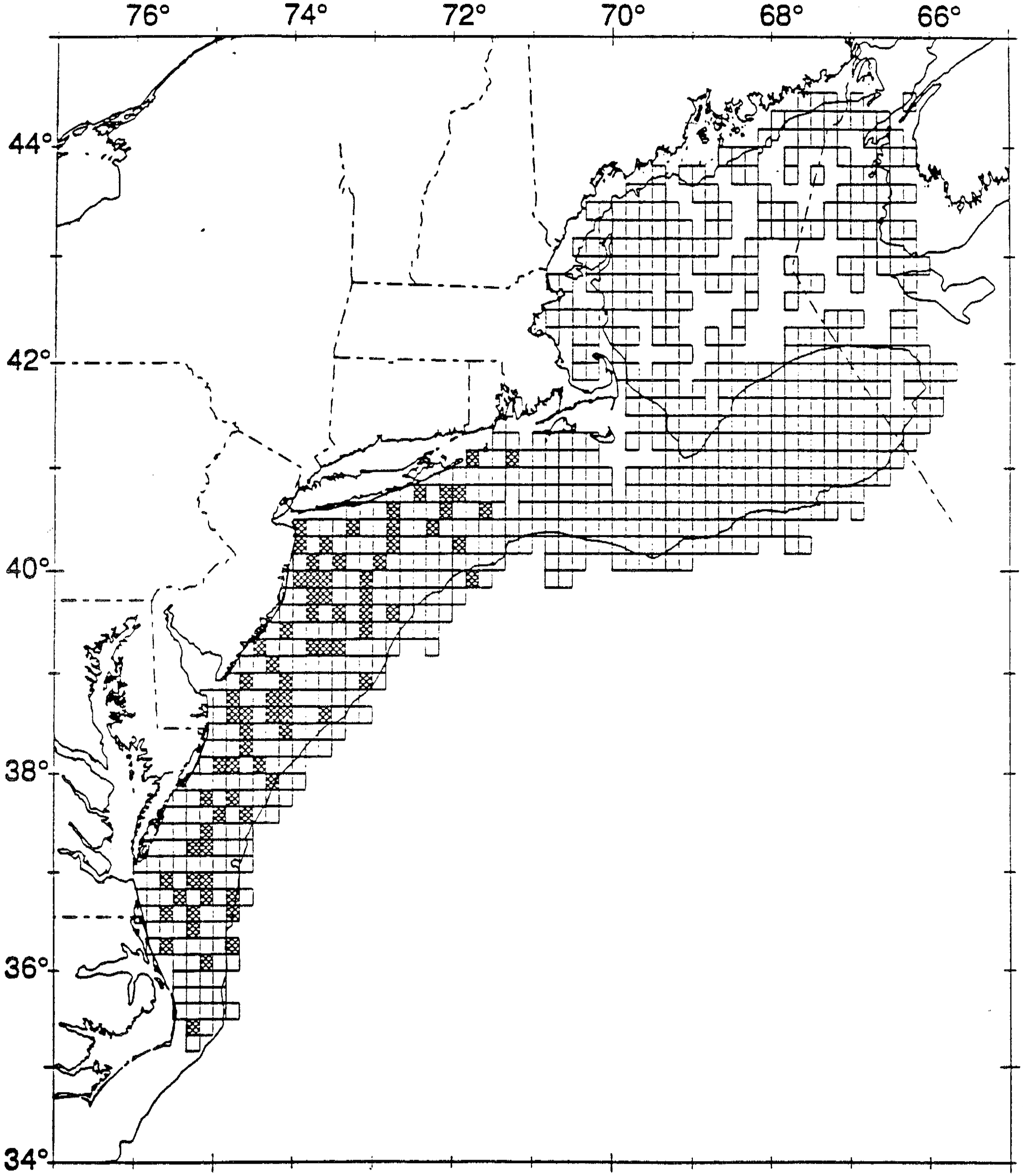

Figure 26. EFH for bluefish eggs, areas which encompass the top 90% of the areas where bluefish eggs were collected in the MARMAP surveys between 1978 and 1987.
Source: Cross pers. com.

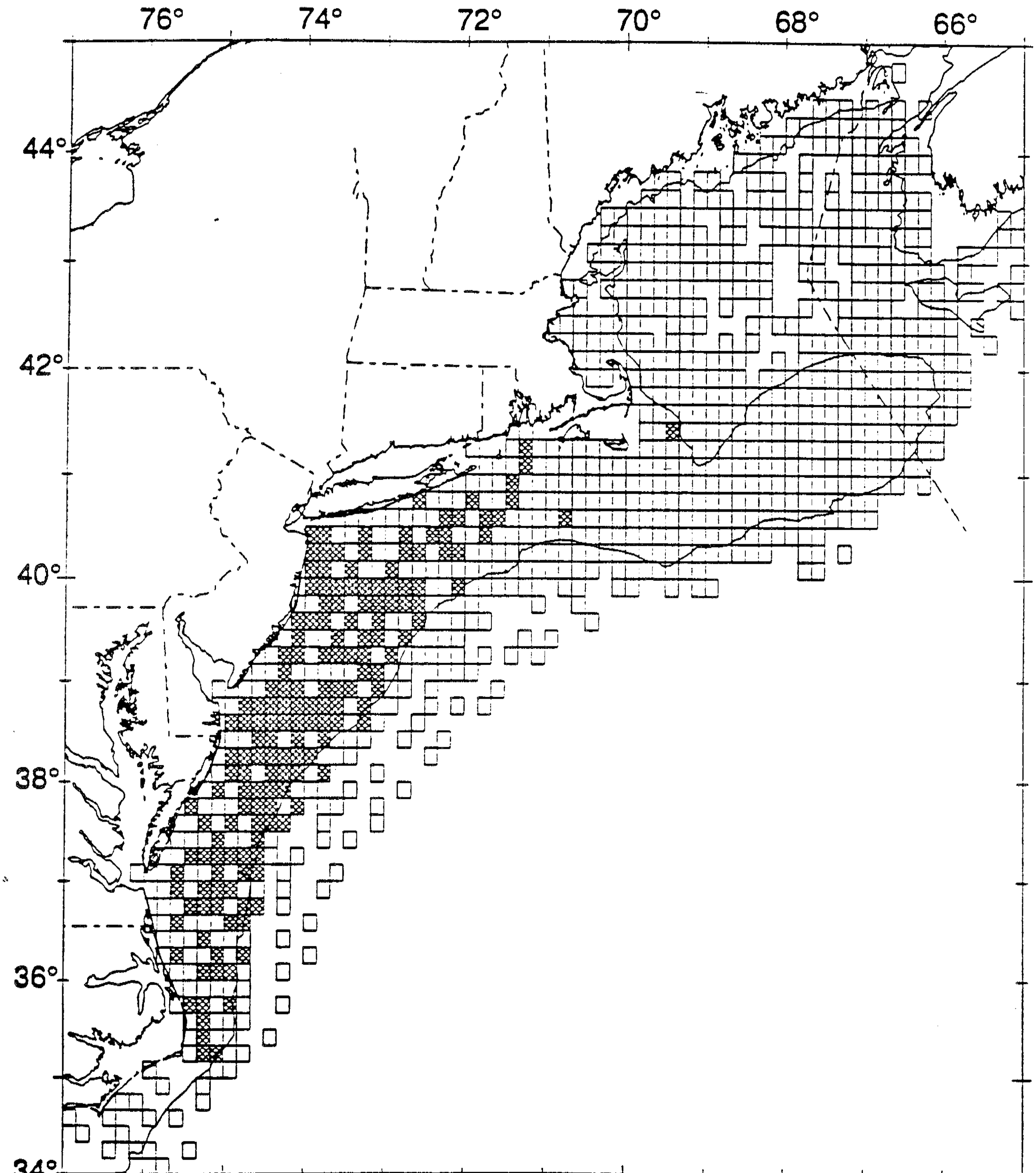

Figure 27. EFH for bluefish larvae, areas which encompass the top 90% of the areas where bluefish larvae were collected in the MARMAP surveys in the MAB between 1978 and 1987 and the SAB between 1973 and 1978. Source: Cross pers. com.

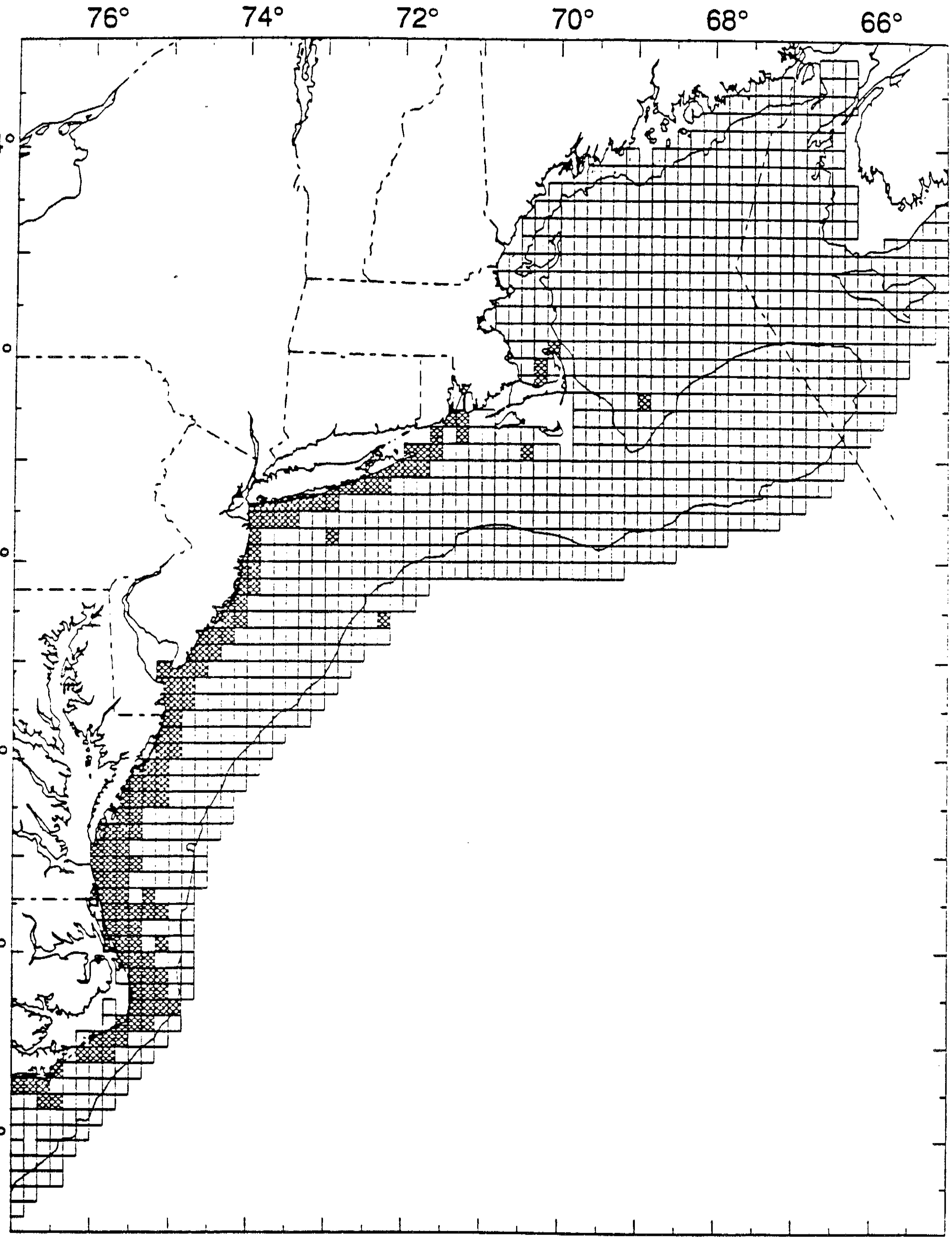

Figure 28. EFH for Bluefish YOY, area which encompasses the top 90% of the areas where bluefish YOY were collected by the NEFSC trawl survey between 1963 and 1966.
Source: Cross pers. com.

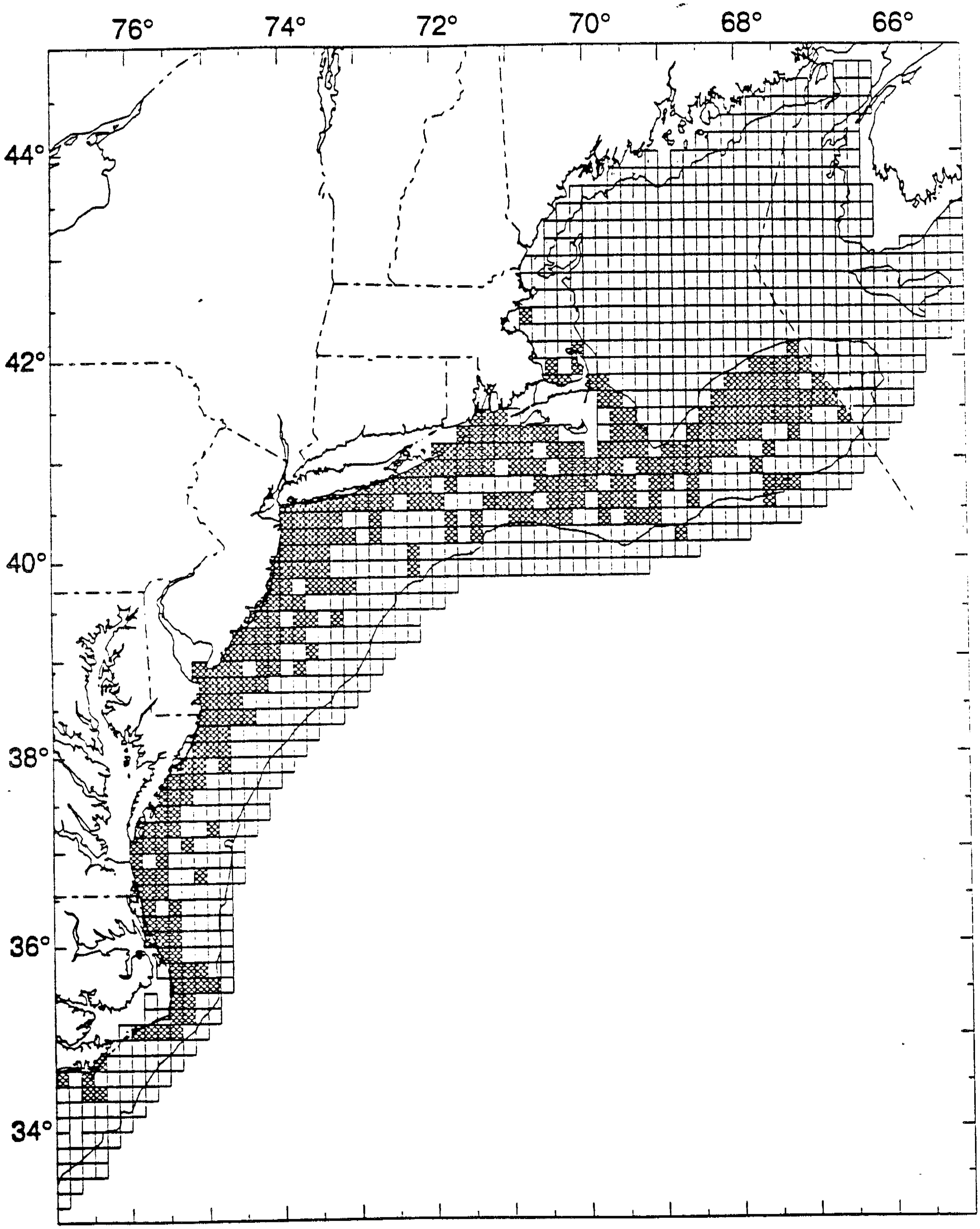

Figure 29. EFH for adult bluefish, areas that encompass the top 90% of the areas where bluefish adults were collected by the NEFSC trawl survey between 1963 and 1996.
Source: Cross pers. com.

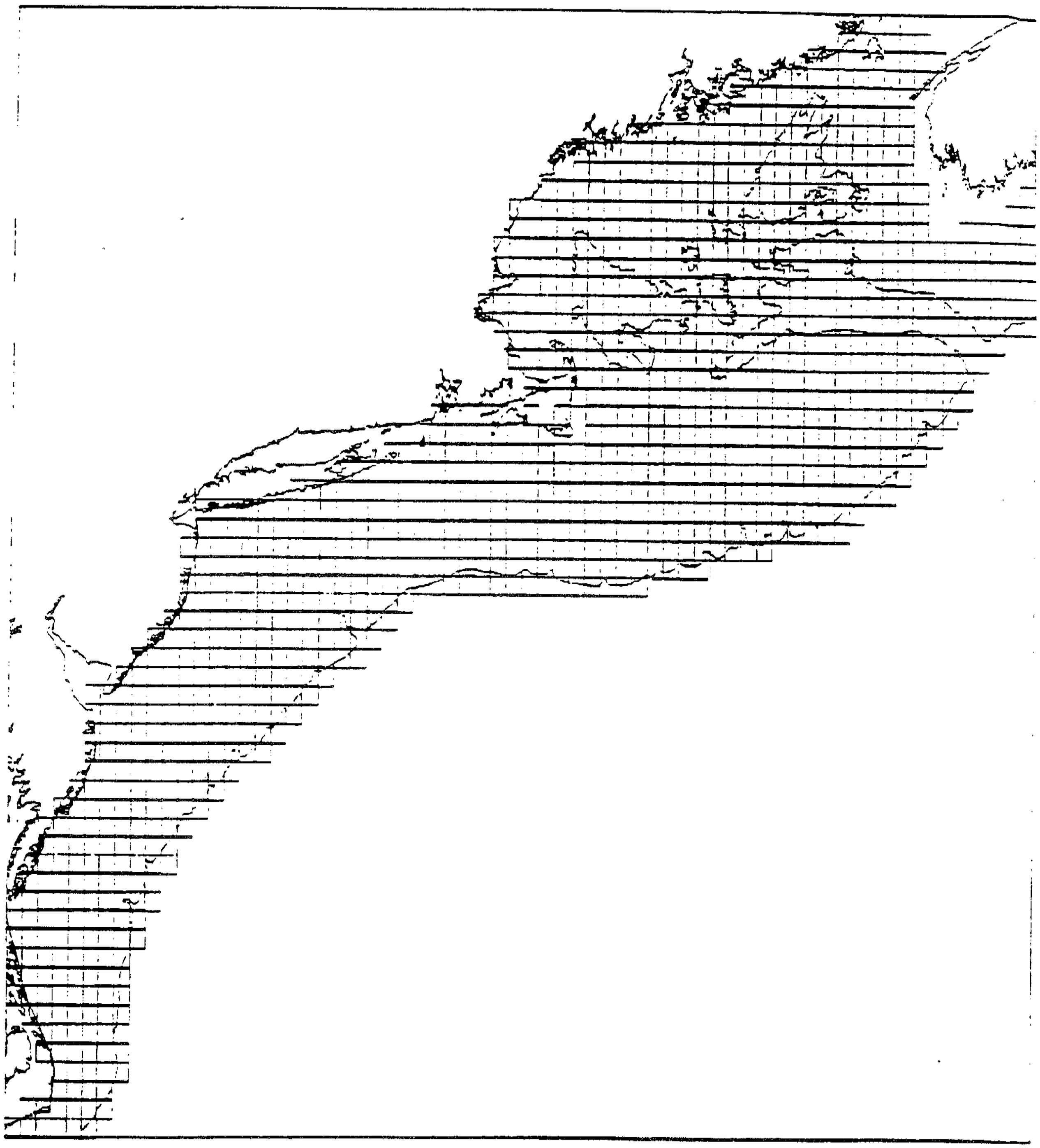

Figure 30. Blank 10 minute grid north of Cape Hatteras, NC for input by the public on bluefish EFH.
Source: Cross pers. com.

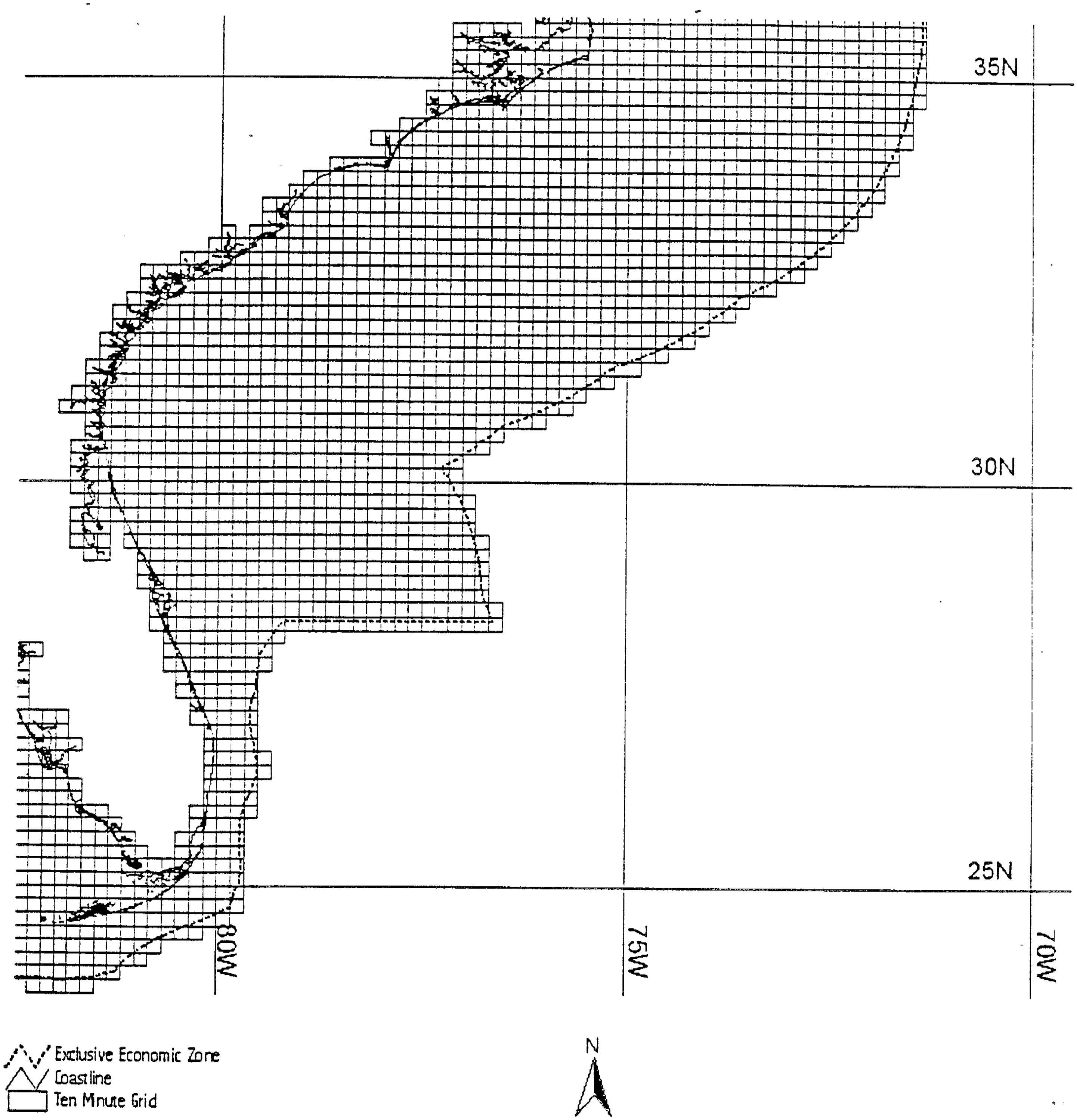

Figure 31. Blank 10 minute grid, south of Cape Hatteras, NC for input by the public on bluefish EFH.
Source: Cross pers. com.

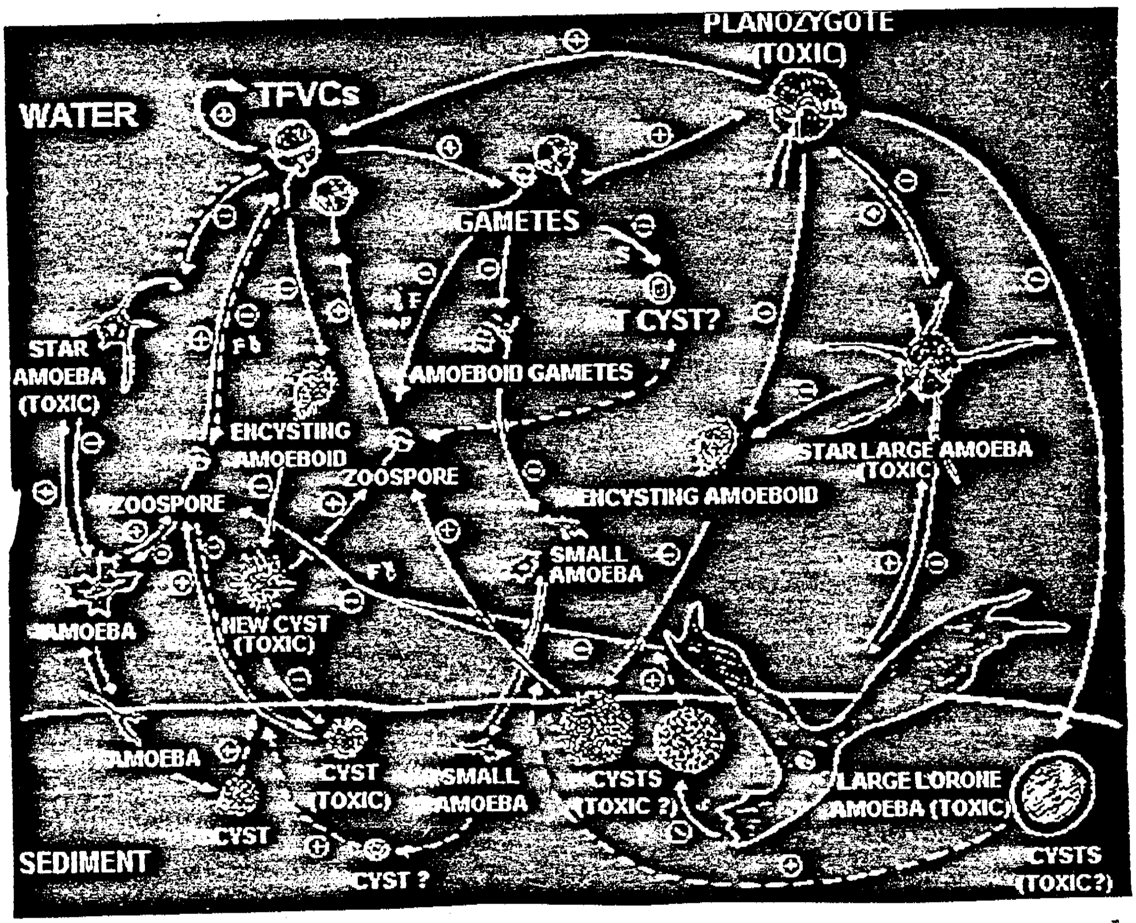

Figure 32. Diagrammatic life history of *Pfiesteria piscicida*.
Source: NCSU 1998.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, Maryland 20910

JUL 2 1999

MEMORANDUM FOR: Gary Matlock
Director, Office of Sustainable Fisheries

FROM: Hilda Diaz-Soltero
Director, Office of Protected Resources

SUBJECT: Consultation on the Fishery Management Plan for the Atlantic Bluefish Fishery and Amendment 1 to the Fishery Management Plan

This document transmits the National Marine Fisheries Service's (NMFS) Biological Opinion based on our review of the Fishery Management Plan for Atlantic Bluefish, including Amendment 1, and the effects of the proposed management actions on North Atlantic right whales, humpback whales; loggerhead, Kemp's ridley, green, and leatherback sea turtles; and shortnose sturgeon in accordance with section 7 of the Endangered Species Act of 1973 as amended (16 U.S.C. 1531 *et seq.*).

We look forward to further cooperation with you in implementing the conditions of this Opinion. As before, my staff is available to assist you as needed.

Attachment

Endangered Species Act - Section 7 Consultation

Biological Opinion

Agency: National Marine Fisheries Service

Activity: Consultation on the Atlantic Bluefish Fishery

Consultation Conducted By: National Marine Fisheries Service, Northeast Region

Date issued: July 2, 1999

This document represents the National Marine Fisheries Service (NMFS) Biological Opinion (Opinion) based on our review of the Atlantic bluefish *(Pomatomus saltatrix)* fishery, the Atlantic Bluefish Fishery Management Plan (FMP), including the proposed Amendment 1[1] for the Atlantic bluefish fishery and its potential for effects on threatened and endangered marine mammals and sea turtles under NMFS jurisdiction, in accordance with section 7 of the Endangered Species Act of 1973, as amended (16U.S.C. 1531 *et seq.*)(ESA).

This Opinion is based on information provided in the Atlantic Bluefish FMP and Amendment 1 (as referenced above) , including the Final Environmental Impact Statement (FEIS) and other information on the fishery contained in NMFS sea sampling database. Formal consultation of this action was initiated on May 10, 1999. A complete administrative record is on file at the Northeast Regional Office, NMFS, Gloucester, Massachusetts.

The Atlantic Bluefish FMP was originally approved in 1990 and since it contains a major inshore element was managed jointly between the Mid-Atlantic Fishery Management Council (MAFMC) and the Atlantic States Marine Fisheries Commission (ASMFC). Amendment 1 was prepared under the Magnuson-Stevens Fishery Conservation and Management Act (M-S Act) as amended under the Sustainable Fisheries Act (SFA) and the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA).

In the Atlantic, the bluefish fishery has historically been primarily a marine recreational fishery. As overseas markets developed for bluefish in the eighties, fishery managers were asked to develop an FMP to protect the important recreational fishery from over harvest by commercial ventures. During those years, 80% of the bluefish catch was reserved for recreational fishermen with the remaining 20% further subdivided among commercial fisheries in the north, mid, and south Atlantic regions (10%, 50%, and 40% respectively). The current FMP includes a license requirement to sell bluefish, possession limits for anglers, including charter boat limitations, and permits for commercial fishermen who can take more than the possession limit. In the current FMP, the commercial fishery is still limited to approximately 20% of the total catch.

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[1]Both plan and amendment received final Mid-Atlantic Fishery Management Council (MAFMC) approval October 7, 1998

Commercial controls limit highly efficient gear that can be identified as responsible for any increases in commercial landings and these limitations on specific gear types in the EEZ include trip limits, area closures, and other measures as appropriate, including gear prohibitions. Development of Amendment 1 began in response to the limited number of management options to control fishing mortality in the existing FMP and also to bring the plan into compliance with the SFA.

A. Consultation History

- December 4, 1989. Informal consultation was concluded on the development of the original bluefish FMP which determined that the fishery would have no effect on endangered or threatened species under NMFS jurisdiction.
- March 8, 1996. Informal consultation was concluded on the proposed rule for withdrawal of Secretarial approval of the FMP for the Atlantic Bluefish FMP and removal of implementing regulations which determined that no new information was available to change the previous conclusion on the fishery and that the withdrawal of the plan itself was not likely to adversely affect any listed species under NMFS jurisdiction.

Since new information on listed species and developments under the Marine Mammal Protection Act of 1972, as amended (MMPA), Sustainable Fisheries Act (SFA) and other ESA related recovery actions have become available since 1996, in addition to new actions under M-S Act (Amendment 1) relative to this fishery, consultation is now being reinitiated. Specifically, this information includes data from the sea sampling program documenting takes of sea turtles during trips where the catch composition show greater than 50% bluefish and development of take reduction plans under the MMPA that address all gillnets regardless of target species, requiring a change in the effect determination and leading to initiation of formal consultation.

AD

B. Description of Proposed Action

Action Area: The management unit for the Bluefish FMP covers United States waters in the western Atlantic Ocean from Maine through Key West, Florida and consequently represents the action area for this consultation.

For a detailed description of this fishery and the management actions refer to *Amendment 1 to the Bluefish Fishery Management Plan, including the Environmental Impact Statement and Regulatory Impact Review* (MAFMC 1998). This document was used in preparation of the following summary:

Pertinent bluefish life history elements: Bluefish are a migratory species found in continental shelf waters in temperate and semi-tropical oceans and range from Nova Scotia to Florida in the northwestern Atlantic. Conflicting hypotheses suggest that spawning either occurs as a protracted season beginning in late winter in slope waters off the southeastern U.S., progressing northward with time, or in two principal areas (South Atlantic Bight and Mid-Atlantic Bight). In general, adult bluefish travel north in spring and summer and south in fall and winter, with the southern migration closer to shore. Some inshore-offshore movement occurs in both migrations.

Temperature and photoperiod are the principle environmental factors directing movements. During summer, stocks are centered between Cape Cod and Chesapeake Bay and in northern North Carolina. Generally, abundance and occurrence varies annually but bluefish are abundant in New England from June through October (peak August-September). In the Mid-Atlantic States abundance peaks between July and October. In the South Atlantic bluefish occur year round, but peak landings are in January. Bluefish, like piscivorous marine mammals, are carnivorous and feed on a variety of pelagic and demersal fish and invertebrates.

Description of the Commercial Fishery. As noted, the management unit for the Bluefish FMP covers United States waters in the western Atlantic Ocean from Maine through Key West, Florida. Based on data from 1987-1996, bluefish are commercially harvested in state and Exclusive Economic Zone (EEZ) waters by many commercial gears with the most bluefish landed by gillnets (48%), otter trawls (19%), fish pound nets (7%), hand and troll lines (6%), and haul seines (3%). The state fisheries vary and add considerable effort with beach haul seines and commercial hand lines. Gillnets including run-around gillnets caught significant amounts of bluefish in most states except Connecticut , South Carolina, Georgia and Florida.

Geographically, most bluefish caught commercially were in state waters except in the New England sub-region where EEZ landings predominate (see attachment 1). For the most part Mid-Atlantic landings predominate over the other two regions with respect to total commercial landings. Average monthly landings from 1987-1996 showed the largest peak in October.

Since US commercial fisheries are expected to harvest the entire Optimum Yield (OY) established for this fishery, no foreign components of this fishery will be authorized. In addition to specifying the OY for the U.S. fishery, the FMP establishes a rebuilding schedule not to exceed 10 years, a requirement for commercial and party/charter vessel permits, dealer permits, and operator permits. A framework adjustment process is also included and the following measures can be frame-worked:

- minimum fish size
- maximum fish size
- gear restrictions
- gear requirements
- permitting restrictions
- recreational possession limits
- recreational season
- closed areas
- commercial season
- description and identification of Essential Fish Habitat and other habitat areas of concern
- any other management measures currently included in the FMP.

For the commercial fishery the plan establishes a commercial quota and 17% (14,262 K pounds) of the Total Allowable Landings are allocated to the commercial fishery based on the average 1981-1989 landings (85,875 K pounds). The fishing mortality target is 0.36 and the current fishing mortality rate is 0.51. The fishing mortality rate producing MSY (target) is 78% of the current fishing mortality.

Description of the Recreational Fishery. The recreational fishery is also largest in the Mid-Atlantic of the three regions (55.7% as compared to 33.1% and 11.2% in the north and south, respectively). It has historically been and currently is one of the most sought after recreational marine fishes in both state and federal waters.

Description of Take Reduction Plans which are part of the scope of this action (the bluefish fishery and associated regulations). Given that gillnets are the primary type of commercial gear that lands bluefish (48% of commercial landings), two take reduction plans (TRP) with regulations promulgated under the Marine Mammal Protection Act of 1972, as amended (MMPA), would affect operation of the commercial bluefish fishery in both state and federal waters. These are the Atlantic Large Whale Take Reduction Plan (ALWTRP)(February 16, 1999) and the Harbor Porpoise Take Reduction Plan (HPTRP) (December 2, 1998).

The ALWTRP. The fisheries affected by the ALWTRP include: Anchored gillnet fisheries including the New England sink gillnet fishery, the Gulf of Maine/U.S. Mid-Atlantic lobster trap/pot fishery, the U.S. mid-Atlantic coastal gillnet fisheries, and the Southeastern U.S. Atlantic shark gillnet fishery. The New England Multispecies sink gillnet fishery has an historical incidental bycatch of humpback, minke, and possibly fin whales. This gear type has been documented to entangle right whales in Canadian waters. Additionally, entanglements of right whales in unspecified gillnets have been recorded for U.S. waters, although U.S. sink gillnets have not been conclusively identified as having entangled right whales. The Gulf of Maine/U.S. mid-Atlantic lobster trap/pot fishery has an historical bycatch of right, humpback, fin and minke whales. The mid-Atlantic coastal gillnet fisheries have an historical incidental bycatch of humpback whales. The Southeastern U.S. Atlantic shark gillnet fishery may have been responsible for bycatch of at least one right whale (NMFS 1997i). Since all anchored gillnets are included in the ALWTRP and bluefish gillnets are included in the Mid-Atlantic coastal gillnet fishery, the bluefish fishery would also be subjected to the requirements of these plans.

As stated above and as required by the MMPA, the plan has two goals. The short-term goal was to reduce serious injuries and mortalities of right whales in U.S. commercial fisheries to below 0.4 animals per year within six months of plan implementation. The long-term goal is to reduce entanglement-related serious injuries and mortalities of right whales, humpback whales, fin whales, and minke whales to insignificant levels approaching a zero mortality and serious injury rate within five years of plan implementation, taking into account the economics of the fisheries, the availability of existing technology, and existing State and regional fishery management plans.

To reach the short-term goal, the ALWTRP implemented the following measures to achieve the necessary take reductions within 6 months through: 1) Closures of critical habitats to some gear types during times when right whales are usually present; 2) restricting the way strike nets are set in the southeastern U.S. gillnet fishery to minimize the risk of entanglement and requiring observers on shark gillnet vessels operating adjacent the southeast U.S. critical habitat; 3) requiring that all lobster and sink gillnet gear be set in such a way as to prevent line from floating at the surface; 4) requiring all lobster and anchored gillnet gear to have at least some additional characteristics that are likely to reduce the risks of entanglements, 5) requiring that drift gillnets in the mid-Atlantic be either tended or stored on board at night; 6) improving the voluntary network of persons trained to assist in disentangling right whales; and 7) prohibiting storage of inactive gear in the ocean.

The steps in the implementation of the ALWTRP designed to achieve the long-term goal include: 1) A commitment to improve public involvement in take reduction efforts, including conducting outreach and educational workshops for fishermen; 2) instituting "Take Reduction Technology Lists" from which fishermen must choose gear characteristics that are intended to decrease the risks of entanglement; 3) facilitating research and development of fishing gear that will reduce the risk of entanglement; 4) continuing to improve the disentanglement effort, including encouraging more cooperation from fishermen; 5) implementing a gear marking program, 6) developing contingency plans in cooperation with states for when right whales are present at unexpected times and places; 7) working with Canada to decrease entanglements in its waters; 8) improving monitoring of the right whale population distribution and biology; 9) conducting aerial surveys to monitor whale distribution, fishing effort and shipping traffic, 10) maintaining a network to alert maritime users about right whale distribution; and 11) establishing the framework of an abbreviated rulemaking process to allow NMFS to change the requirements of the plan through notification in the Federal Register, thereby improving the responsiveness of NMFS.

NMFS will continue to use the ALWTRT, an advisory group that includes fishermen, scientists, and representatives of environmental groups and state governments, to review progress on reaching the goals of the ALWTRP and to make recommendations on how to continue to decrease serious injuries and mortalities due to entanglements. NMFS also intends to continue to seek technical advice on matters pertaining to gear development through its Gear Advisory Group (GAG), which is composed of persons with direct knowledge of fishing gear or disentangling large whales. NMFS convened the GAG in October 1998, and the TRT met in February 1999 to review this plan and its associated final rule. NMFS modified the plan in a final rule (February 16, 1999) based on TRT recommendations as follows:

(1) Definition of lobster trap was changed to be : "any trap, structure or other enclosure that is placed on the ocean bottom and is designed or is capable of catching lobsters. This change was to prevent the confusion found in the interim rule definition where it was not clear that applied only to traps and not gillnets or bottom trawls that could catch lobster. This new definition does, however, explicitly include traps for other species such as black sea bass and scup.

(2) Definition of gillnet was broadened so that minor alterations in design, verticality, tie-downs etc did not exclude nest intended to be included from plan requirements.

(3) Exempted waters in the Gulf of Maine were eliminated which will ensure consistency in gear, particularly in Maine waters.

(4) Exempted waters were added in Rhode Island to eliminate certain coastal ponds and rivers where right whales have never been seen.

(5) Gear marking requirements were restricted to apply only to critical habitats, Stellwagen Bank and Jeffrey's Ledge and were stayed until the GAG and ALWTRT can define an appropriate scheme.

(6) Lobster gear requirements in Cape Cod Bay were made consistent with the regulations set by the Commonwealth of Massachusetts.

(7) The interim final rule allowed gillnetters to place extra weights onto the leadline to increase holding power of their nets. The concept was to anchor the nets to make it easier for a whale to break free. However, this only works in conjunction with weak links elsewhere, not as an alternative to weak links, which is what was allowed under the IFR. Therefore, the anchoring option was eliminated in the final rule.

To date, entanglements of right whales have occurred since plan implementation. Some of these entanglements resulted in successful disentanglements, some did not. At this time we have no evidence as to whether the whales that were not disentangled suffered serious injury. The ALWTRP has been successful in that entangled whales are being sighted more often and disentanglement teams have been responding more efficiently and effectively as a result of outreach and education efforts and expansion of disentanglement capabilities. Given the relative rarity of events, there are not yet enough data to say how much the rate of entanglement has been reduced. The Team did not recommend any major changes at the last meeting and it is still expected that the whale plan will meet its goals. The gillnet portion of the bluefish fishery takes place in the areas and times that are affected by the ALWTRP and consequently the regulatory components are an integral part of scope of activities that constitute the bluefish fishery and the scope of action considered in this consultation that are expected to reduce the potential for impact from the fishery.

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The HPTRP. The HPTRP requires one set of management measures in New England and one set of measures in the Mid-Atlantic. In New England the plan consists of a series of time/area closures where no fishing with gillnets is allowed, and also a series of much larger closures in both time and area where fishing with gillnets is allowed as long as acoustic deterrent devices, "pingers", are on the nets.

Gulf of Maine time/area closures to gillnet fishing and periods during which pinger use are required under the Final Rule/HPTRP

Northeast Area:	
August 15 - September 13	Closed
Mid-Coast Area:	
September 15 - May 31	Closed, gillnet with pingers allowed
Massachusetts Bay Area:	
December 1 - February 28/29	Closed, gillnet with pingers allowed
March 1 - 31	Closed
April 1 - May 31	Closed, gillnet with pingers allowed
Cape Cod South Area:	
December 1 - February 28/29	Closed, gillnet with pingers allowed
March 1 - 31	Closed
April 1 - May 31	Closed, gillnet with pingers allowed
Offshore Area:	
November 1 - May 31	Closed, gillnet with pingers allowed

Cashes Ledge Area:	
February 1 - 28/29	Closed

In the Mid-Atlantic, the plan consists of three time/area 20-30 day closures in addition to gear modification requirements from January through May. These modifications consist of a minimum twine size requirement, limits on the length of net panels, limits on the total length of float line, and tie-down restrictions. Commercial gillnets in the bluefish fishery would have to comply with these regulations.

Management measures for the large mesh gillnet (includes gillnet with mesh size greater than 7 inches (17.78cm) to 18 inches (45.72cm)) fishery in the Mid-Atlantic under the final rule/HPTRP.

Floatline Length:	
New Jersey Mudhole	Less than or equal to 3,900 ft (1188.7 m)
New Jersey Waters (excluding the Mudhole)	Less than or equal to 4,800 ft (1463.0 m)
Southern Mid-Atlantic	Less than or equal to 3,900 feet(1188.7 m)
Twine Size:	
All Mid-Atlantic Waters	Greater than or equal to .90 mm (.035 inches)
Tie Downs:	
All Mid-Atlantic Waters	Required
Net Cap:	
All Mid-Atlantic Waters	80 nets
Net Size:	A net must be no longer than 300 feet (91.4m) long
Net Tagging:	Requires all nets to be tagged by January 01, 2000
Time/Area Closures:	
New Jersey waters out to 72°30' W. longitude (including the Mudhole)	Closed from April 1 -April 20
New Jersey Mudhole	Closed from February 15 - March 15
Southern Mid-Atlantic waters (MD, DE, VA, NC) out to 72°30' W. longitude	Closed from February 15 - March 15

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Management measures for the small mesh gillnet fishery (includes gillnet with mesh size of greater than 5 inches (12.7 cm) to less than 7 inches (17.78cm)) in the Mid-Atlantic under the final rule/HPTRP.

Floatline Length:	
New Jersey waters	less than or equal to 3,000 feet (914.4 m)
Southern Mid-Atlantic waters	less than or equal to 2,118 feet (645.6 m)
Twine Size:	greater than or equal to .81 mm (.031 inches) in all Mid-Atlantic waters
Net Cap:	45 nets in all Mid-Atlantic waters
Net Size:	A net must be no longer than 300 feet (91.4m) long.
Net Tagging:	Requires all nets to be tagged by January 01, 2000
Time/Area Closures:	
New Jersey Mudhole	Closed from February 15 - March 15

The closures and gear modifications under the HPTRP would apply to anchored gillnets for bluefish.

C. Status of Listed Species and Critical Habitat

The following listed species under the jurisdiction of the NMFS are known to occur in the action area (Atlantic Ocean, Maine through Key West, Florida) and may be affected by fishing activity for bluefish:

Loggerhead sea turtle	*Caretta caretta*	Threatened
Kemp's ridley sea turtle	*Lepidochelys kempi*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Green sea turtle[2]	*Chelonia mydas*	Endangered
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered
North Atlantic right whale	*Eubalaena glacialis*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Johnson's seagrass	*Halophila johnsonii*	Threatened

While sperm whales (*Physeter macrocephalus),* blue whales (*Baleanoptera musculus*) and sei whales *(Balaenoptera borealis*) are endangered, occur in the action area, and could become entangled in fishing gear, given the primarily coastal nature of this fishery and the more pelagic distribution of these species, NMFS has determined that fishing gear targeting bluefish is not likely to adversely affect sperm whales, blue whales and sei whales. In addition, due to the primary location and habitats for hawksbill sea turtles and Johnson's seagrass in the southeastern US, NMFS has also determined that fishing gear targeting bluefish is not likely to adversely affect hawksbill sea turtles or Johnson sea grass that may be present in the action area. Therefore, these species will not be discussed further in this Biological Opinion.

<u>Critical Habitat Designations</u>

North Atlantic right whale	Cape Cod Bay and Great South Channel off Massachusetts and the FL/GA breeding/calving grounds

Background information on the range-wide status of these species and a description of critical habitat can be found in a number of published documents. General information on the potential for entanglement in the gear types used in the bluefish fisheries is likely to be similar to that summarized in previous consultations on the Multispecies FMP, including the June 12, 1986, November 30, 1993, February 18, 1996, and December 13, 1996 (NMFS 1996a, 1996c) Biological Opinions and the December 21, 1998 Monkfish Opinion. Additional sources include recent sea turtle status documents (NMFS and USFWS 1995, USFWS 1997), Recovery Plans for the humpback whale (NMFS 1991a), right whale (NMFS 1991b), loggerhead sea turtle (NMFS & USFWS 1991) and leatherback sea turtle (NMFS & USFWS 1992), the status reports on Kemp's ridley and loggerhead sea turtles provided by the Marine Turtle Expert Working Group

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[2]Green turtles in US waters are listed as threatened except for the Florida breeding population which is listed as endangered. Due to inability to distinguish between the populations away from the nesting beach, green turtles are considered endangered wherever they occur in U.S. waters.

(TEWG 1998) and the 1998 marine mammal stock assessment report (Waring *et al.* 1999). Summary information on the biology of these species is provided below. Information in the human impacts sections on "takes" refers to entanglements in gillnet or trawl mesh or capture in trawl gear.

a. Loggerhead Sea Turtle

Distribution: The threatened loggerhead is the most abundant species of sea turtle in U.S. waters, commonly occurring throughout the inner continental shelf from Florida through Cape Cod, Massachusetts. The loggerhead's winter and early spring range is south of 37°00' N in estuarine rivers, coastal bays, and shelf waters of the southeastern United States. Loggerheads move northward and enter northeast coastal embayments as water temperatures approach 20°C (Burke *et al.* 1989; Musick *et al.* 1984) to feed on benthic invertebrates, leaving the northern embayments in the fall when water temperatures drop.

The activity of the loggerhead is limited by temperature. Keinath *et al.* (1987) observed sea turtle emigration from the Chesapeake Bay when water temperatures cooled to below 18°C, generally in November. Work in North Carolina showed a significant movement of sea turtles into more northern waters at 11°C (Chester *et al.* 1994) and Morreale (NMFS and USFWS 1995) has seen sea turtles persist in New York waters for extended periods at temperatures as low as 8°C. Surveys conducted offshore and sea turtle strandings during November and December off North Carolina suggest that sea turtles emigrating from northern waters in fall and winter months may concentrate in nearshore and southerly areas influenced by warmer Gulf stream waters (Epperly *et al.* 1995). This is supported by the collected work of Morreale and Standora (see Morreale and Standora, 1998) who tracked 12 loggerheads and 3 kemp's ridleys by satellite. All of the turtles tracked similar spatial and temporal corridors, migrating south from Long Island Sound, NY, in a time period of October through December. The turtles traveled within a narrow band along the continental shelf and became sedentary for one to two months south of Cape Hatteras. Some of the turtles lingered between Cape Lookout Shoals and Frying Pan Shoals offshore of Wilmington, North Carolina prior to moving south or into the Gulf Stream.

Aerial surveys of loggerhead turtles at sea north of Cape Hatteras indicate that they are most common in waters from 22 to 49m deep, although they range from the beach to waters beyond the continental shelf (Shoop and Kenney 1992). There is no information regarding the activity of these offshore turtles.

Population status: During 1996, a Turtle Expert Working Group (TEWG) met on several occasions and produced a report assessing the status of the loggerhead sea turtle population in the Western North Atlantic (WNA). Of significance is the conclusion that in the WNA, there are at least 4 loggerhead subpopulations separated at the nesting beach (TEWG 1998). This finding was based on analysis of mitochondrial DNA, which the turtle inherits from its mother. It is theorized that nesting assemblages represent distinct genetic entities, but further research is necessary to address the stock definition question. These nesting subpopulations include the following areas: northern North Carolina to northeast Florida, south Florida, the Florida Panhandle, and the Yucatan Peninsula. Genetic evidence has shown that loggerheads from

Chesapeake Bay southward to Georgia are nearly equally divided in origin between South Florida and northern subpopulations. Work is currently ongoing in the Northwestern North Atlantic to collect samples which will provide information relative to turtles north of the Chesapeake, which is most of the action area for this consultation.

The loggerhead turtle was listed as "threatened" under the ESA on July 28, 1978, but is considered endangered by the World Conservation Union (IUCN) and under the Convention on International Trade in Endangered Species of Flora and Fauna (CITES). The significance of the results of the TEWG analysis is that the northern sub-population may be experiencing a significant decline (2.5% - 3.2% for various beaches). A recovery goal of 12,800 nests has been assumed for the Northern sub-population, but current nests number around 6,200 (TEWG 1998). Since the number of nests have declined in the 1980's, the TEWG concluded that it is unlikely that this sub-population will reach this goal. Considering this apparent decline as well as the lack of information on the sub-population from which loggerheads in the WNA are derived, progress must continue to reduce the adversely affect of fishing and other human-induced mortality on this population.

The most recent 5-year ESA sea turtle status review (NMFS & USFWS 1995) reiterates the difficulty of obtaining detailed information on sea turtle population sizes and trends. Most long-term data is from the nesting beaches, and this is often complicated by the fact that they occupy extensive areas outside U.S. waters. This status review supports the conclusion of the TEWG that the northern sub-population may be experiencing a decline and that inadequate information is available to assess whether its status has changed since the initial listing as threatened in 1978. The current recommendation from the 5-year review is to retain the threatened designation but note that further study is needed before the next status review is conducted.

Recent mortality and human impacts: Human-caused mortality and serious injury to loggerheads in the action area of this consultation are varied and many are difficult to quantify. The largest impacts are from nest disturbances and predations, fishing interactions (particularly the shrimp fishery and other trawl and gillnet fisheries, and the longline fishery for tuna, swordfish, and sharks (for 1995 this was an estimate in excess of 1500 turtles, many of which ingested the hook). The level of mortality in the longline fishery was estimated at 30% in the biological opinion on the fishery, based on a limited study, but true mortality estimates are not available at this time. Trawlers in the southeastern U.S. are required to use turtle excluder devices (TEDs) in the shrimp fishery which have been reported as having reduced lethal takes by 54% and declines have also been observed in the summer flounder fishery that is equipped with TEDs (TEWG, 1998). NMFS (1998d) estimated that 4100 turtles may be captured annually by shrimp trawling (650 leatherbacks that cannot be released through TEDs, 1700 turtles taken in try nets, and 1750 turtles that fail to escape through the TED). Henwood and Stuntz (1987) reported that the mortality rate for trawl caught turtles range between 21% and 38 %, but others (Magnuson et al 1990) suggested that those rates were conservative and likely underestimate the true mortality rate.

Work is ongoing to continue to evaluate this question in addition to a review of all fisheries in the western Atlantic for which observer data is available. Bycatch estimates for loggerheads will be made for all fisheries with sufficient sample sizes to produce reasonable CVs on the estimates. This will be compiled in an assessment report which is expected by the end of 1999. At that time, estimates will be used to re-evaluate the fisheries to which they pertain through reinitiation of appropriate consultations.

Until that work is completed the only information on magnitude of take available for fisheries, other than the estimated take levels available for the shrimp and pelagic fishery are observed takes from the sea sampling. A preliminary data pull (1994-1998) from the NEFSC sea sampling database shows the following total loggerhead entanglements, hooking or entrainment: 209 (longline), 23 (otter trawl), 18 (coastal trawl), 15 (anchored gillnet), 82 (pelagic driftnet), 1 (scallop dredge). Considering that barely 5% coverage is achieved in the anchored gillnet fishery, one of the higher rates of observer coverage, the actual number of takes in fisheries combined is likely significant.

b. Leatherback Sea Turtle

Distribution: The leatherback is the largest living turtle and ranges farther than any other sea turtle species, exhibiting broad thermal tolerances (NMFS & USFWS 1995). Leatherback turtles feed primarily on cnidarians (medusae, siphonophores) and tunicates (salps, pyrosomas) and are often found in association with jellyfish. These turtles are found throughout the action area of this consultation and, while predominantly pelagic over the entire action area, they occur annually in more coastal areas like Cape Cod Bay and Narragansett Bay, and inshore waters of North Carolina during certain times of the year, fall in the north and spring in the south. Of the turtle species common to the action area, leatherback turtles seem to be the most susceptible to entanglement in lobster gear and longline gear. This susceptibility may be the result of attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface.

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Population status: Nest counts are the only reliable population information available for leatherback turtles. Recent declines have been seen in the number of leatherbacks nesting worldwide (NMFS & USFWS 1995). The status review notes that it is unclear whether this observation is due to natural fluctuations or whether the population is at serious risk With regard to repercussions of these observations for U.S. leatherback populations in general, it is unknown whether they are stable, increasing, or declining, but it is certain that some nesting populations (*e.g.*, St. John and St. Thomas, U.S. Virgin Islands) have been extirpated.

Recent mortality and human impacts: Information on human-caused mortality and serious injury for leatherbacks is even more scarce than it is for loggerheads. A working group meeting was held in the northeast in 1998 to develop a management plan for leatherbacks and experts expressed the opinion that incidental takes in fisheries were likely higher than is being reported. Two to three leatherbacks are reported entangled in lobster gear every year. Anecdotal accounts by fishermen support the idea that they have many more encounters than are reported. Prescott (1988) reviewed stranding data for Cape Cod Bay and concluded that for those turtles where cause of death could be determined (the minority), entanglement is the leading cause of death followed by capture by dragger, cold stunning, or collision with boats. Many leatherback-fishery interactions seem to be indicative of entanglement in buoy lines and longline gear as compared to gillnets and trawl gear. Annual estimates of take of leatherbacks in the longline fishery reported in the latest biological opinion was 690 (average 1994-1995) and it is expected that the level of take has not decreased in recent years. Entanglements have been reported in all gear types used in the bluefish fishery. Leatherback bycatch estimates will be included in the analysis discussed above, expected later this year, which will provide a better assessment of overall fishery mortality than is currently available.

Preliminary sea sampling data summaries as mentioned above for loggerheads (1994-1998) shows the following observed takes of leatherbacks: 1 (longline), 4 (anchored gillnet), 1 (pelagic gillnet).

c. Kemp's Ridley Sea Turtle

Distribution: Juvenile Kemp's ridleys use northeastern and mid-Atlantic coastal waters of the U.S. Atlantic coastline as primary developmental habitat during summer months, with shallow coastal embayments serving as important foraging grounds. Post-pelagic ridleys feed primarily on crabs, consuming a variety of species including: *Callinectes* sp., *Ovalipes* sp., *Libinia* sp., and *Cancer* sp. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997). Juvenile ridleys migrate south as water temperatures cool in the fall, and are predominantly found in shallow coastal embayments along the Gulf Coast during fall and winter months.

Ridleys found in mid-Atlantic waters are primarily post-pelagic juveniles averaging 40 centimeters in carapace length, and weighing less than 20 kilograms (Terwilliger and Musick 1995). Next to loggerheads, they are the second most abundant sea turtle in Virginia and Maryland waters, arriving in these areas during May and June and emigrating to more southerly waters from September to November (Keinath *et al.* 1987; Musick and Limpus 1997). In the Chesapeake Bay, ridleys frequently forage in shallow embayments, particularly in areas supporting submerged aquatic vegetation (Lutcavage and Musick 1985; Bellmund *et al.* 1987; Keinath *et al.* 1987; Musick and Limpus 1997). The juvenile population in Chesapeake Bay is estimated to be 211 to 1,083 turtles (Musick and Limpus 1997). They are predominantly found in shallow coastal embayments along the Gulf Coast during fall and winter months.

Juvenile ridleys follow regular coastal routes during spring and fall migrations to and from developmental foraging grounds along the mid-Atlantic and northeastern coastlines. Consequently, many ridleys occurring in coastal waters off Virginia and Maryland are transients involved in seasonal migrations. However, Maryland's and Virginia's coastal embayments, which contain an abundance of crabs, shrimp, and other prey as well as preferred foraging habitat such as shallow subtidal flats and submerged aquatic vegetation beds, are likely used as a foraging ground by Kemp's ridley sea turtles (John Musick, Virginia Institute of Marine Science, 1998, pers. comm.; Sherry Epperly, NMFS Beaufort Laboratory, Beaufort North Carolina, 1998, pers. comm.; Molly Lutcavage, New England Aquarium, 1998 pers. comm.). Nesting is undocumented for Virginia or Maryland beaches and rarely occurs outside the Gulf of Mexico.

Population status: The Kemp's ridley is one of the most endangered of the world's sea turtle species. The only major nesting site for ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963). Estimates of the adult population reached a low of 1,050 in 1985, and have increased to 3,000 individuals in 1997. First-time nesting adults have increased from 6% to 28% from 1981 to 1989, and from 23% to 41% from 1990 to 1994, indicating that the ridley population may be in the early stages of exponential growth (TEWG 1998).

Recent mortality and human impacts: Mortality in the large juvenile and adult life stage would have the greatest impact to the Kemp's ridley population (TEWG, 1998). The vast majority of ridleys identified along the Atlantic Coast have been juveniles and subadults. Sources of mortality in this area include incidental takes in fishing gear, pollution and marine habitat degradation, and other man-induced and natural causes. Loss of individuals, particularly large juveniles, in the Atlantic may therefore impede recovery of the Kemp's ridley sea turtle population. As with loggerheads, a large number of Kemp's ridleys are taken in the shrimp fishery each year and in trawl and gillnet fisheries up and down the Atlantic coast. As for the other species, estimates of total fishery mortality, other than work done on the shrimp fishery, are not available at this time. The TEWG (1998) concluded, as they did for loggerheads, that given the state of existing data, the total number of Kemp's ridley turtles that could be incidentally taken during commercial fishing above current levels without slowing recovery of this species cannot be estimated at this time.

d. Green sea turtle

Distribution: Green turtles are distributed circumglobally, mainly in waters between the northern and southern 20°C isotherms (Hirth, 1971). In the western Atlantic, several major nesting assemblages have been identified and studied (Peters, 1954; Carr and Ogren, 1960; Parsons, 1962; Pritchard, 1969; Carr *et al.*, 1978). However, most green turtle nesting in the continental United States occurs on the Atlantic Coast of Florida (Ehrhart, 1979). Several nests are reported each year for the Florida panhandle (FLDEP, unpublished data). Most green turtle nesting activity occurs on Florida index beaches. These index beaches were established to standardize data collection methods and effort on key nesting beaches. The pattern of green turtle nesting shows biennial peaks in abundance, with a generally positive trend during the six years of regular monitoring since establishment of the index beaches in 1989.

While nesting activity is obviously important in determining population distributions, the remaining portion of the green turtle's life is spent on the foraging grounds. Some of the principal feeding pastures in the western Atlantic Ocean include the upper west coast of Florida, the northwestern coast of the Yucatan Peninsula, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean Coast of Panama, and scattered areas along Colombia and Brazil (Hirth, 1971). The preferred food sources in these areas are *Cymodocea, Thalassia, Zostera, Sagittaria, and Vallisneria* (Carr, 1952; 1954; Mexico, 1966).

Although no green turtle foraging areas or major nesting beaches have been identified on the Atlantic Coast, evidence provided by Mendonca and Ehrhart (1982) indicates that immature green turtles may utilize lagoonal systems for foraging. These authors identified a population of young green turtles (carapace length 29.5-75.4 cm) believed to be resident in Mosquito Lagoon, Florida. The Indian River system, of which Mosquito Lagoon is a part, supported a green turtle fishery during the late 1800s (Ehrhart, 1983), and these turtles may be remnants of this historical colony. Additional juvenile green turtles occur north to Long Island Sound, presumably foraging in coastal embayments. In North Carolina, green turtles are known from estuarine and oceanic waters. Recently, green turtle nesting occurred on Bald Head Island, just east of the mouth of the Cape Fear River, on Onslow Island, and on Cape Hatteras National Seashore. No information is available regarding the occurrence of green turtles in the Chesapeake Bay, although they are presumably present in very low numbers.

Recent mortality and human impacts: The shrimp fishery has been estimated as taking as many as 300 turtles a year. In addition, stranding reports indicate that between 200-300 green turtles stand annually (STSSN data) from a variety of causes. As with the other turtle species fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction account for an unknown level of other mortality. Green turtle takes have been documented in gillnet, trawl and longline gear. Preliminary sea sampling data summary (1994-1998) shows the following takes of green turtles: 1 (anchored gillnet), 2 (pelagic driftnet), 2 (pelagic longline).

e. **Shortnose sturgeon**

Distribution: Shortnose sturgeon occur in large rivers along the western Atlantic coast from the St. Johns River, Florida (possibly extirpated from this system), to the Saint John River in New Brunswick, Canada. The species is anadromous in the southern portion of its range (*i.e.*, south of Chesapeake Bay), while northern populations are amphidromous (NMFS 1998f). Popuation sizes vary across the species' range.

Shortnose sturgeon are benthic fish that mainly occupy the deep channel sections of large rivers. They feed on a variety of benthic and epibenthic invertebrates including molluscs, crustaceans (amphipods, chironomids, isopods), and oligochaete worms (Vladykov and Greeley 1963; Dadswell 1979). Shortnose sturgeon are long-lived (30 years) and, particularly in the northern extent of their range, mature at late ages. In the north, males reach maturity at 5-10 years, while females mature between 7 and 13 years.

In the northern extent of their range, shortnose sturgeon exhibit three distinct movement patterns that are associated with spawning, feeding, and overwintering periods. In spring, as water temperatures rise above 8° C, pre-spawning shortnose sturgeon move from overwintering grounds to spawning areas. Spawning occurs from mid/late April to mid/late May. Post-spawned sturgeon migrate downstream to feed throughout the summer. As water temperatures drop below 8° C again in the fall, shortnose sturgeon move to overwintering concentration areas and exhibit little movement until water temperatures rise again in spring (Dadswell *et al.* 1984; NMFS 1998). Young-of-the-year shortnose sturgeon are believed to move downstream after hatching (Dovel 1981) but remain within freshwater habitats. Older juveniles tend to move downstream in fall and winter as water temperatures decline and the salt wedge recedes. Juveniles move upstream in spring and feed mostly in freshwater reaches during summer.

Shortnose sturgeon spawn in freshwater sections of rivers, typically below the first impassable barrier on the river (*e.g.*, dam). Spawning occurs over channel habitats containing gravel, rubble, or rock-cobble substrates (Dadswell *et al.* 1984; NMFS 1998). Additional environmental conditions associated with spawning activity include decreasing river discharge following the peak spring freshet, water temperatures ranging from 9 -12° C, and bottom water velocities of 0.4 - 0.7 m/sec (Dadswell *et al.* 1984; NMFS 1998).

Population status: From available estimates, smallest populations occur in the Cape Fear (~ 8 adults) (Moser and Ross 1995) and Merrimack Rivers (~ 100 adults) (M. Kieffer, United States Geological Survey, personal communication), and the largest populations are found in the Saint John (~ 100,000) (Dadswell 1979) and Hudson Rivers (~ 35,000) (Bain et al. 1995). Total instantaneous mortality rates (Z) are available for the Saint John River (0.12 - 0.15; ages 14-55) (Dadswell 1979), Upper Connecticut River (0.12) (Taubert 1980), and Pee Dee-Winyah River (0.08-0.12) (Dadswell *et al.* 1984). Total instantaneous natural mortality (M) for shortnose sturgeon in the lower Connecticut River was estimated to be 0.13 (T. Savoy, Connecticut Department of Environmental Protection, personal communication). There is no recruitment information available for shortnose sturgeon because there are no commercial fisheries for the species. Estimates of annual egg production for this species are difficult to calculate because females do not spawn every year (Dadswell *et al.* 1984). Further, females may abort spawning attempts, possibly due to interrupted migrations or unsuitable environmental conditions (NMFS 1998). Thus, annual egg production is likely to vary greatly in this species.

Recent mortality and human impacts: Gillnet fisheries and trawl fisheries are known to occur in both the northern and southern portion of the shortnose sturgeon's range. Although no entanglement or interaction have been observed on trips targeting bluefish, the more inshore nature of this fishery, the difficulty in distinguishing shortnose from Atlantic sturgeon, and the growth in populations of some rivers, makes it likely that more interactions with gillnet or trawl gear may occur than has been observed or reported. Documented human impacts to sturgeon also include power plant and dredge interactions, although the magnitude of any of these factors is not known.

AG

g. North Atlantic Right Whale

Distribution: With the exception of time spent in Canadian waters, most of the species' geographic range is within the action area for this consultation. In the action area as a whole, right whales are present throughout the year, but occur in different parts of the action area at different times of the year.

NMFS designated right whale critical habitat on June 3, 1994 (59 FR 28793). These waters, which lie within the action area, include the waters of Cape Cod Bay and the Great South Channel off the coast of Massachusetts, and off the coasts of southern Georgia and northern Florida, where the species aggregates at different times of the year.

In the northern critical habitats, whales are most abundant in Cape Cod Bay between February and April (Hamilton and Mayo 1990; Schevill *et al.* 1986; Watkins and Schevill 1982) and in the Great South Channel in May and June (Kenney *et al.* 1986, Payne *et al.* 1990). Right whales also frequent the Bay of Fundy, Browns and Baccaro Banks (in Canadian waters), Stellwagen

Bank and Jeffrey's Ledge in spring and summer, and use mid-Atlantic waters as a migratory pathway between winter (mid-November through March) calving grounds and their spring and summer nursery/feeding areas in the Gulf of Maine. Recent satellite tracking efforts have identified individual animals embarking on far-ranging foraging episodes not previously known (Knowlton, pers. comm.). Right whales in the Gulf of Maine feed on zooplankton, primarily copepods, by skimming at or below the water's surface with open mouths (see NMFS 1991b, Kenney *et al.* 1986, Murison and Gaskin 1989, Mayo and Marx 1990).

Population trends: Attempts have been made to determine the current status and trends of this very small population and to make valid recommendations on recovery requirements. Through 1998, biological opinions cited Knowlton *et al.* (1994) which concluded, based on data from 1987 through 1992, that the northern right whale population was growing at a net annual rate of 2.5% (CV = 0.12). This rate is also used in NMFS' marine mammal Stock Assessment Report (e.g. Blaylock *et al.* 1995, Waring *et al.* 1997). Since then, data used by Knowlton *et al.* (1994) have been re-evaluated, and new attempts to model the trends of the northern right whale population have been published (e.g., Kraus 1997; Caswell *et al.* 1999) and additional works are in progress (Caswell *et al.*, 1999.; Wade and Clapham, in prep). These analyses suggest that the western North Atlantic stock has been in decline in the 1990's.

Recognizing the precarious status of the right whale globally, the International Whaling Commission (IWC) held a special meeting of its Scientific Committee from March 19-25, 1998, in Cape Town, South Africa, to conduct a comprehensive assessment of right whales worldwide. Workshop participants reviewed available information on the northern right whale, including Knowlton *et al.* (1994), Kraus (1997), and Caswell *et al.* (1999). After considering this information, the workshop attendees concluded that it is unclear whether the Western North Atlantic stock of the northern right whale population is "declining, stationary or increasing, and [that] the best estimate of current population size is only 300 animals." Maintaining a conservative stance due to these uncertainties, participants concluded that the growth rate of this population "is both low and substantially less than that of the southern right whale populations" (IWC in press).

Workshop participants expressed "considerable concern" in general for the status of the Western North Atlantic population. Based on recent (1993-1995) observations of inconsistent calf production, the relatively large number of human-induced mortalities, and an observed increase in the calving interval, it has been suggested that the slow but steady recovery rate published in Knowlton *et al.* (1994) may not be continuing. The Caswell *et al.* (1999) work was reviewed at the Cape Town workshop, received considerable peer review since that time, and was revised accordingly prior to publication. Reviewers concurred with Caswell *et al.*'s (1999) conclusion that the population trajectory has declined from an approximately 2.5% annual increase to one which is declining at a rate of approximately 2.4% annually. This re-analysis incorporated previous concerns regarding possible bias in sampling effort after surveys in the Great South Channel ceased. Other works in progress are likely not to be inconsistent with this conclusion (Wade and Clapham, in prep., Caswell *et al.*, 1999). Nonetheless, the Caswell et al. model suggests that the northern right whale will be extinct in 100-200 years; at the current rate of decline "functional" extinction will likely occur in 50 years.

Therefore, it is essential to remain diligent in efforts to control human-induced adverse effects to this population in order to avoid jeopardy from such activities. For the purposes of this Biological Opinion, NMFS will assume, until published estimates become available, that the northern right whale population is declining. This approach is more protective of the northern right whale than alternative assumptions. IWC Workshop participants urgently recommended increased efforts to determine the trajectory of the northern right whale population, and NMFS' Northeast Fisheries Science Center has already begun to implement that recommendation.

Recent mortality and human impacts: Six right whale mortalities resulting from various causes were recorded in 1996 (see NMFS Biological Opinion, May 29, 1997 for detailed information on these mortalities). In addition to these mortalities, 2 reports of right whale entanglement in fishing gear were received during 1996. One, classified as a serious injury, was not relocated; the other was disentangled and was seen the following year with a calf. Data from 1997 indicate that one mortality occurred from unknown causes, another mortality occurred due to a ship strike in the Bay of Fundy, and 8 entanglements were reported. Six of the entanglements were reported in Canadian waters and 2 in U.S. waters (one of the reports may represent a re-sighting of an earlier entanglement). In 1998, two known mortalities occurred, as evidenced by stranded carcasses. The first was the mortality of a calf due to natural causes and the second was an adult (probable) male, for which cause of death has not yet been determined. Two adult female right whales were discovered in a weir off Grand Manan Island in the Bay of Fundy on July 12, 1998, and were released two days later; no residual injuries were reported. On July 24, 1998, the Disentanglement Team removed line from around the tail stock of a right whale which was originally seen entangled in the Bay of Fundy on August 26, 1997. This same whale, apparently debilitated from the earlier entanglement, became entangled in lobster pot gear twice in one week in Cape Cod Bay in September 1998. The gear from the latter two entanglements was completely removed, but line remained in the animal's mouth. On August 15, 1998, a right whale was observed entangled in the Gulf of St. Lawrence; the animal apparently freed itself of most of the gear, but it is unknown whether gear remains on the animal. Thus far in 1999, one whale stranded with evidence of ship strike and 2 likely entanglements were reported. Neither of these whales were successfully disentangled and the affects on the animal remain unknown

The IWC workshop recommended that the following activities be undertaken to reduce the adverse effects of entanglement in fishing gear:

- research into methods to reduce right whale entanglements in fishing gear,
- determination and monitoring of entanglement rates and the success of steps to reduce entanglement,
- modification of protective measures, if shown to be insufficient,
- establishment of disentanglement programs, and
- consideration of prohibition of any gear that might entangle right whales in high-use habitats, especially in calving, breeding or feeding areas, and sanctuaries.

All of these recommendations are presently being implemented via similar recommendations of the ALWTRP as part of implementation of the TRP.

h. Humpback Whale

Distribution: As with right whales, a large portion of the species' geographic range is within the action area for this consultation. Humpback whales feed in the northwestern Atlantic during summer and migrate to calving and mating areas in the Caribbean. Five separate feeding areas are utilized in northern waters; one, the Gulf of Maine feeding area, lies within U.S. waters and is in the action area of this consultation. Most of the humpback whales that forage in the Gulf of Maine visit Stellwagen Bank and the waters of Massachusetts and Cape Cod bays. Sightings are most frequent from mid-March through November between 41°N and 43°N, from the Great South Channel north along the outside of Cape Cod to Stellwagen Bank and Jeffreys Ledge (CeTAP, 1982), and peak in May and August. Small numbers of individuals may be present in this area year-round, including the waters of Stellwagen Bank.

Katona and Beard (1990) summarized information gathered from a catalogue of photographs of 643 individuals from the western North Atlantic population of humpback whales. These photographs indicated reproductively mature western North Atlantic humpback whales winter in tropical breeding grounds in the Antilles, primarily on Silver and Navidad Banks, north of the Dominican Republic. The primary winter range also includes the Virgin Islands and Puerto Rico (see NMFS, 1991). In general, it is believed that calving and mating take place in winter range. Calves are born from December through March and are about 4 meters at birth. Sexually mature females give birth approximately every 2 to 3 years. Sexual maturity is reached between 4 and 6 years of age for females and between 7 and 15 years for males. Size at maturity is about 12 meters.

Swingle *et al.* (1993) identified an increase of juvenile humpback whales in the nearshore waters of Virginia, primarily in winter. Those photo-identified were known members of the Gulf of Maine feeding group, suggesting a shift in distribution that may be related to winter prey availability. Studies conducted by the Virginia Marine Science Museum (VMSM) indicate that these whales are feeding on, among other things, bay anchovies and menhaden. Researchers theorize that juvenile humpback whales, that do not participate in the migration to Caribbean waters, may be establishing a winter foraging area in the mid-Atlantic (Mayo, pers. comm.). In concert with the increase in mid-Atlantic whale sightings, strandings of humpback whales have increased between New Jersey and Florida since 1985. Strandings were most frequent during September through April in North Carolina and Virginia waters, and were composed primarily of juvenile humpback whales of no longer than 11 meters (Wiley *et al.*, 1995). Six of 18 humpbacks (33 percent) for which the cause of mortality was determined were killed by vessel strikes. An additional humpback whale had scars and bone fractures indicative of a previous vessel strike that may have contributed to the whale's death. Sixty percent of those mortalities that were closely investigated showed signs of entanglement or vessel collision (Wiley *et al.*, 1995).

Population Status: Recent information has become available on the status and trends of the humpback whale population, although there are still insufficient data to determine population trends for the Western North Atlantic stock (Waring *et al.* 1997). The current rate of increase of the North Atlantic humpback whale population has been estimated at 9.0% (CV=0.25) by Katona and Beard (1990) and at 6.5% by Barlow and Clapham (1997). Palsboll *et al.* (1997) studied humpback whales through genetic markers to identify individual humpback whales in the northern Atlantic Ocean. Using breeding ground samples from 1992–1993, Palsboll *et al.* (1997) estimated the North Atlantic humpback whale population at 4,894 (95% confidence interval 3,374 - 7,123) males and 2,804 females (95% confidence interval 1,776 -4,463), for a total of 7,698 whales. However, since the sex ratio in this population is known to be 1:1 (Palsboll et al., 1997), the lower figure for females is presumed to be a result of sampling bias or some other cause for partitioning of the sampling. Photographic mark-recapture analyses from the YONAH (Years of the North Atlantic Humpback) project gave an ocean-basin-wide estimate of 10,600 (95% c.i. = 9,300 - 12,100) and an additional genotype-based analysis yielded a similar but less precise estimate of 10,400 (95% c.i. = 8,000 - 13,600) (Smith *et al.* 1999). The estimate of 10,600 is regarded as the best available estimate for this population. The minimum population estimate for the North Atlantic humpback whale population is 10,019 animals (CV=0.067) (Waring *et al.* 1999).

Recent mortality and human impacts: In 1996, three humpback whales were killed in collisions with vessels and at least five were seriously injured by entanglement in the same year. At least three humpback whale entanglements were reported in 1997. Stranding records for 1997 for the U.S. Atlantic coast include seven stranded/dead floating humpback whales. Two of these deaths were attributed to ship strikes. For 1998, 14 humpback whale entanglements resulting in injury (n = 13) or mortality (n = 1) were reported. Two of the whales with entanglement injuries stranded dead, but the role of the entanglement in the whales' death has not been determined. Three of the injured animals were completely disentangled, one partially disentangled, one partially disentangled and which later shed the remaining gear, and one shed the gear without assistance from the Disentanglement Team. An additional death (recorded off North Carolina) was attributed to vessel strike. One injury from a vessel interaction involving a known whale was reported in 1998; the whale, which was seen several times after the injury, exhibited some healing. At least three incidents of dead floating humpback whales were also reported as of December 1998; however, cause of death has not been determined for any of these animals. One entanglement of a humpback whale has been reported so far in 1999, the whale was successfully disentangled by a disentanglement team offshore of Cape Lookout, North Carolina.

A9

i. Fin Whale

Distribution: The fin whale is ubiquitous in the North Atlantic and occurs from the Gulf of Mexico and Mediterranean Sea northward to the edges of the arctic ice pack (Waring *et al.* 1999). The overall pattern of fin whale movement is complex, consisting of a less obvious north-south pattern of migration than that of right and humpback whales. Based on acoustic recordings from hydrophone arrays, however, Clark (1995) reported a general southward "flow pattern" of fin whales in the fall from the Labrador/Newfoundland region, south past Bermuda, and into the West Indies. The overall distribution may be based on prey availability, and fin whales are found throughout the action area for this consultation in most months of the year. This species preys opportunistically on both invertebrates and fish (Watkins *et al.* 1984). As with humpback whales, they feed by filtering large volumes of water for prey. Fin whales are larger and faster than humpback and right whales and are less concentrated in nearshore environments. Due to these traits, fin whales are less prone to entanglements than are right and humpback whales, however because their distribution overlaps that of commercial fishing activities, the potential exists for entanglement in fishing gear used in the bluefish fishery.

Population status: Hain *et al.* (1992) estimated that about 5,000 fin whales inhabit the northeastern United States continental shelf waters. Shipboard surveys of the northern Gulf of Maine and lower Bay of Fundy targeting harbor porpoise for abundance estimation provided an imprecise estimate of 2,700 (CV=0.59) fin whales (Waring *et al.* 1997).

Recent mortality and human impacts: Of 18 fin whale mortality records collected between 1991 and 1995, four were associated with vessel interactions, although the proximal cause of mortality was not known. In 1996, three reports of ship strikes were received, although this was only confirmed as cause of death for one of the incidents. One entanglement report was received in 1996. At least five reports of entangled fin whales were received by NMFS in 1997. Four fin whales were reported as having stranded in the period from January 1, 1997, to January 1, 1998, in the Northeast Region; the cause of death was not determined for these animals. One ship strike mortality was documented in 1998 in the Virginia-North Carolina border area. One entanglement mortality was reported in September 1998.

j. Right Whale Critical Habitat

It is likely that not all areas of right whale occurrence have been identified. For example, about 80% of the population is unaccounted for in the winter. Genetics work performed by Schaeff *et al.* (1993) suggested the existence of at least one unknown nursery area. Within the known distribution of the species, however, the following five areas have been identified as critical to the continued existence of the species: (1) coastal Florida and Georgia; (2) the Great South Channel, east of Cape Cod; (3) Cape Cod and Massachusetts Bays; (4) the Bay of Fundy; and (5) Browns and Baccaro Banks, south of Nova Scotia. The first three areas occur in U.S. waters and have been designated by NMFS as critical habitat (59 FR, 28793, June 3, 1994).

The availability of dense concentrations of zooplankton in the winter (Cape Cod Bay) and spring (Great South Channel) is described as the key factor for right whale utilization of the areas. Kraus and Kenney (1991) provide an overview of data regarding right whale use of these areas. Important habitat components in Cape Cod Bay include seasonal availability of dense zooplankton patches and protection from weather by the land masses surrounding the bay. The spring current regime and bottom topography of the Great South Channel result in nutrient rich upwelling conditions. These conditions support the dense plankton and zooplankton blooms utilized by right whales. However, the combination of highly oxygenated water and dense zooplankton concentrations are optimal conditions for the small schooling fishes (sand lance, herring, and mackerel) that are preferred prey of several piscivorous marine mammal species such as humpback and fin whales, Atlantic whitesided dolphins, pilot whales, and harbor porpoise. Concentrations of these species were observed in this region during the same spring period (CeTAP 1982).

In 1993/1994, NMFS, the U.S. Coast Guard (USCG), the U.S. Navy (USN), and the U. S. Army Corps of Engineers (ACOE) began a program to monitor the presence of right whales in and adjacent to the U.S. southeast right whale critical habitat, in order to reduce the potential for ship-whale collisions. A number of collaborative efforts have resulted in coverage of not only the coastal, high-use area where whales frequently traverse major shipping lanes, but also less densely concentrated areas (both in terms of whale and vessel traffic) to the north, south, and east of this high-use area. Public sightings are also investigated and verified to ensure mariner notification of all confirmed right whale sightings in the area.

In 1997, NMFS, the USCG, and the Commonwealth of Massachusetts began a similar program to monitor the presence of right whales in and adjacent to the Cape Cod Bay and Great South Channel habitats in order to reduce the potential for ship-whale collisions in these waters. Sightings in other parts of the Northeast are also investigated. One such investigation revealed the presence of 23 individual whales in one day off Rhode Island in an area of heavy shipping traffic. These monitoring programs, known as the Early Warning System (EWS), also known as the Whale Alert Program, are described in more detail in the Environmental Baseline Section. Important information has been collected through the EWS which may enable NMFS to identify additional critical habitat areas as well as to refine the time and area boundaries of the known existing critical habitat areas and peak usage periods.

D. Environmental Baseline

Environmental baselines for Biological Opinions include the past and present impacts of all state, Federal or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR § 402.02). The environmental baseline for this Biological Opinion includes the effects of several activities that affect the survival and recovery of threatened and endangered species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally fall into the following three categories: vessel operations, fisheries, and recovery activities associated with reducing those impacts. Other environmental impacts include effects of discharges, dredging, ocean dumping, sonic activity, and aquaculture.

1. Status of the species within the action area

The listed species occurring in the action area are all highly migratory, and the scope of the action area includes the western Atlantic from Maine to Florida. Therefore, the range-wide status of the species given in the previous section most appropriately reflects the species' status within the action area.

2. Factors affecting the species within the action area

a. Federal actions that have undergone Formal or Early section 7 consultation.

In the past four years, NMFS has undertaken several ESA section 7 consultations to analyze the effects of vessel operations and gear associated with Federally-permitted fisheries on threatened and endangered species in the action area. Each of those consultations sought to develop ways of reducing the probability of adverse effects of the action on large whales and sea turtles. Similarly, recovery actions NMFS has undertaken under both the MMPA and the ESA are addressing the problem of take of whales in the fishing and shipping industries.

(1) *Vessel Operations*
Potential adverse effects from Federal vessel operations in the action area of this consultation include operations of the U.S. Navy (USN) and U.S. Coast Guard (USCG), which maintain the largest Federal vessel fleets, the Environmental Protection Agency, the National Oceanic and Atmospheric Administration (NOAA), and the ACOE. NMFS has conducted formal consultations with the USCG, the USN (described below) and is currently in early phases of consultation with the other Federal agencies on their vessel operations (ACOE, USGS). NMFS has consulted with the ACOE to provide recommended permit restrictions for operations of contract or private vessels around whales. Through the section 7 process, where applicable, NMFS has and will continue to establish conservation measures for all these agency vessel operations to avoid adverse effects to listed species. At the present time, however, they represent potential for some level of interaction. Refer to the Biological Opinions for the USCG (NMFS 1995, 1996b, and 1998) and the USN (NMFS 1997a) for detail on the scope of vessel operations for these agencies and conservation measures being implemented as standard operating procedures.

Since the USN consultation only covered operations out of Mayport, Florida, potential for USN vessels to adversely affect large whales when they are operating in other areas within the range of these species has not been assessed. Similarly, operations of vessels by other Federal agencies within the action area (NOAA, EPA, ACOE) may adversely affect whales. However, the in-water activities of those agencies are limited in scope, as they operate a limited number of vessels or are engaged in research/operational activities that are unlikely to contribute a large amount of risk for large whales. Through the consultation process, conservation recommendations will be provided to reduce that potential even further.

(2) *Additional military activities*, including vessel operations and ordnance detonation, also affect listed species of sea turtles. USN aerial bombing training in the ocean off the southeast U.S. coast, involving drops of live ordnance (500 and 1,000-lb bombs) is estimated to have the potential to injure or kill, annually, 84 loggerheads, 12 leatherbacks, and 12 greens or Kemp's ridley, in combination (NMFS, 1997b). The USN will also conduct ship-shock testing for the new SEAWOLF submarine off the Atlantic coast of Florida, using 5 submerged detonations of 10,000 lb explosive charges. This testing is estimated to injure or kill 50 loggerheads, 6 leatherbacks, and 4 hawksbills, greens, or Kemp's ridleys, in combination (NMFS, 1996b). Operation of the USCG's boats and cutters in the U.S. Atlantic, meanwhile, is estimated to take no more than one individual turtle—of any species—per year (NMFS, 1995). Formal consultation on USCG or USN activities in the Gulf of Mexico has not been conducted.

The construction and maintenance of Federal navigation channels has also been identified as a source of sea turtle and shortnose sturgeon mortality. Hopper dredges, which are frequently used in ocean bar channels and sometimes in harbor channels and offshore borrow areas, move relatively rapidly (compared to sea turtle swimming speeds) and can entrain and kill sea turtles, presumably as the drag arm of the moving dredge overtakes the slower moving turtle. Along the Atlantic coast of the southeastern United States, NMFS estimates that annual, observed injury or mortality of sea turtles from hopper dredging may reach 35 loggerheads, 7 greens, 7 Kemp's ridleys, and 2 hawksbills (NMFS, 1997c). Along the north and west coasts of the Gulf of Mexico, channel maintenance dredging using a hopper dredge may injure or kill 30 loggerhead, 8 green, 14 Kemp's ridley, and 2 hawksbill sea turtles annually (NMFS, 1997d). Additional incidental take statements for dredging of Charlotte Harbor and Tampa Bay, FL anticipate the incidental take, by injury or mortality, of two (2) loggerheads or one (1) Kemp's ridley or one (1) green or one (1) hawksbill sea turtle for Charlotte Harbor and eight (8) sea turtles, including no more than five (7) documented Kemp's ridley, hawksbill, leatherback, or green turtles, in any combination, for Tampa Bay. Three to five shortnose sturgeon have been taken annually in hydraulic pipeline dredging in the Delaware River and they have been documented entrained in a hopper dredge in the Savannah River, Georgia.

3) Federal Fishery Operations

Adverse effects on threatened and endangered species from several types of fishing gear occur in the action area. Efforts to reduce the adverse effects of commercial fisheries are addressed through both the MMPA take reduction planning process discussed earlier and the ESA section 7 process. Gillnet, longline, trawl gear, and pot fisheries have all been documented as interacting with either whales or sea turtles or both. For all fisheries for which there is a Federal fishery management plan (FMP) or for which any Federal action is taken to manage that fishery, impacts will be evaluated under section 7.

Several formal consultations have been conducted on the following fisheries that NMFS has determined are likely to adversely affect threatened and endangered species: American Lobster, Monkfish, Northeast Multispecies, Atlantic Pelagic Swordfish/Tuna/Shark, and Summer Flounder/Scup/ Black Sea Bass fisheries. These consultations are summarized below; for more detailed information, refer to the respective Biological Opinions.

The *Northeast Multispecies Sink Gillnet Fishery* is one of the other major fisheries in the action area of this consultation that is known to entangle whales and sea turtles. This fishery has historically occurred from the periphery of the Gulf of Maine to Rhode Island in water to 60 fathoms. In recent years, more of the effort in this fishery has occurred in offshore waters and into the Mid-Atlantic. Participation in this fishery declined from 399 to 341 permit holders in 1993 and is expected to continue to decline as further groundfish conservation measures are implemented. The fishery operates throughout the year with peaks in the spring and from October through February. Data indicate that gear used in this fishery has seriously injured northern right whales, humpback whales, fin whales, and loggerhead and leatherback sea turtles. Waring *et al.* (1997) reports that 17 serious injuries or mortalities of humpback whales from 1991 to 1996 were fishery interactions (not necessarily multispecies gear), the majority of which indicated some kind of monofilament like that used in the multispecies fishery. It is often difficult to assess gear found on stranded animals or observed at sea and assign it to a specific fishery. Only a fraction of the takes are observed, and the catch rate represented by the majority of takes, which are reported opportunistically, *i.e.*, not as part of a random sampling program, is unknown. Consequently, the total level of interaction cannot be determined through extrapolation.

NMFS recently concluded formal consultation on the *Federally regulated American Lobster Fishery* to consider potential effects of the transfer of management authority from the MSFCMA to the Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA), the implementation of new lobster management actions under the ACFCMA, and recent takes of endangered whales in the fishery. The transfer of authority is being carried out in step-wise fashion, and is currently in an interim phase. The previous formal consultation on the fishery under the MSFCMA had reached a jeopardy conclusion for the northern right whale with the Biological Opinion issued December 13, 1996. As a result of the Reasonable and Prudent Alternative included with the 1996 Biological Opinion, an emergency regulation under the Marine Mammal Protection Act (MMPA) (Emergency Interim Final Rule, 62 FR 16108) was published when implementing restrictions on the use of lobster pot gear in the Federal portion of the Cape Cod Bay right whale critical habitat and in the Great South Channel right whale critical habitat during periods of expected peak right whale abundance. This is still in effect but under the regulations for the ALWTRP.

The proposed ACFCMA plan contains measures to limit the number of lobster traps that can be deployed during the first two years of the plan, and further trap reduction measures may be chosen as default effort reduction measures during subsequent plan years. The reduction in the number of traps fished is expected to result in a reduction of entanglement risk. The interaction between the lobster trap fishery and endangered whales is addressed in the Atlantic Large Whale Take Reduction Plan (ALWTRP) implemented via an interim final rule November 15, 1997, followed by a final rule issued February 16,1999. The ALWTRP incorporated the RPA issued with the 1996 Biological Opinion and implemented additional restrictions. Because of the greater protection provided by the ALWTRP, NMFS substituted the ALWTRP for the RPA issued with the 1996 Biological Opinion and has concluded that the lobster fishery in the context of the ALWTRP is likely to adversely affect but is not likely to jeopardize the northern right whale. Additional description of the ALWTRP is provided in the proposed action section of this BO.

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The monkfish fishery is prosecuted with northeast multispecies-type gear, and therefore has potential to interact with large whales and is also known to interact with sea turtles. NMFS (1998g) concluded in a Biological Opinion issued December 21, 1998, that conduct of the monkfish fishery, with modification to reduce impacts of entanglement through the ALWTRP and the HBTRPs, may adversely affect but is not likely to jeopardize the continued existence of endangered and threatened species under NMFS jurisdiction and is not likely to destroy or adversely modify right whale critical habitat.

The conversion of the monkfish fishery into a regulated fishery has the potential to benefit protected species management by the overall monitoring of effort patterns in the fishery. It will also be beneficial to begin identification and tracking of monkfish-only gillnet permit holders to include them in outreach efforts regarding the MMPA Marine Mammal Authorization Program (MMAP) and take reduction plans. These vessel operators may not be aware that they are considered to be part of the Northeast sink gillnet or Mid-Atlantic coastal gillnet fisheries, which are required to register in the MMAP and are regulated by the whale and porpoise TRPs, respectively. The identification of these vessels will also facilitate effective placement of observers. The ITS provided under the monkfish Opinion anticipates an incidental take by entanglement or capture of 6 loggerhead sea turtles (no more than 3 lethal), 1 lethal or non-lethal entanglement or capture of a green sea turtle, 1 lethal or non-lethal entanglement or capture of a Kemp's ridley, and 1 lethal or non-lethal entanglement or capture of a leatherback. The dogfish fishery has not previously been consulted on, but it is expected that the Mid-Atlantic Fisheries Management Council will be submitting an FMP for this fishery in the near future, on which NMFS will conduct an ESA section 7 consultation.

The *Summer Flounder, Scup and Black Sea Bass fisheries* are known to interact with sea turtles. While not documented, the gear-types used in this fishery could entangle endangered whales, particularly humpback whales. Significant measures have been developed to reduce the take of sea turtles in summer flounder trawls and trawls that meet the definition of a summer flounder trawl (which would include fisheries for other species like scup and black sea bass) by requiring Turtle Excluder Devices (TED) in nets in the area of greatest bycatch off the North Carolina coast. NMFS is considering a more geographically inclusive regulation to require TEDs in trawl fisheries that overlap with sea turtle distribution to reduce the impact from this fishery. Developmental work is also ongoing for a TED that will work in the flynets used in the weakfish portion of this fishery. These fisheries are subject to the requirements of the ALWTRP for gillnets and lobster pots in the Mid-Atlantic. The anticipated observed annual take rates for turtles in this multispecies fishery is 15 loggerheads and 3 leatherbacks, hawksbills, greens, or Kemp's ridley, in combination (NMFS, 1997g).

Similarly, the *squid, mackerel, butterfish fishery* (SMB) is known to interact with sea turtles. While entanglements have not documented, the gear-types used in this fishery could entangle endangered whales. After reviewing the best available information on the status of endangered and threatened species under NMFS jurisdiction, the environmental baseline for the action area, the effects of the action, and the cumulative effects, NMFS concluded in a Biological Opinion issued in April 1999, that operation of the SMB fishery may adversely affect but is not likely to jeopardize the continued existence of endangered and threatened species under NMFS jurisdiction and is not likely to destroy or adversely modify any critical habitat. Limited observer information on this fishery provided a level of anticipated take of less than 10 turtles, for which an incidental take statement was issued.

The *Southeast U.S. Shrimp Fishery* is known to interact with sea turtles. Shrimp trawlers in the southeastern U.S. are required to use TEDs, which reduce a trawler's capture rate by 97%. Even so, NMFS estimated that 4,100 turtles may be captured annually by shrimp trawling, including 650 leatherbacks that cannot be released through TEDs, 1,700 turtles taken in try nets, and 1,750 turtles that fail to escape through the TED (NMFS, 1998d). Henwood and Stuntz (1987) reported that the mortality rate for trawl-caught turtles ranged between 21% and 38%, although Magnuson *et al.* (1990) suggested Henwood and Stuntz's estimates were very conservative and likely an underestimate of the true mortality rate. Work continues on new TED technology and on bycatch and population assessment techniques to continue to improve the evaluation of this fishery and minimize the impacts.

On November 15, 1997, NMFS implemented the interim final rule for the *Atlantic Large Whale Take Reduction Plan* and issued the final rule February 16, 1999. This plan is designed to reduce the rate of serious injury and mortality of right, humpback, fin, and minke whales incidental to the Northeast sink gillnet, lobster pot, Southeast shark gillnet, and Mid-Atlantic gillnet fisheries to acceptable removal levels as defined in the MMPA. A section 7 consultation was conducted on this Plan, including the operation of the four fisheries regulated by the Plan, which concluded, with a no jeopardy Biological Opinion on the interim final rule issued on July 15, 1997 (NMFS 1997e) (and with an informal consultation on the final rule concluded February 16, 1999 (NMFS 1999), which determined that the basis upon which the previous consultation was concluded was unchanged) that the implementation of the ALWTRP and continued operation of these fisheries may adversely affect, but is not likely to jeopardize the continued existence of any listed species of large whales or sea turtles under NMFS jurisdiction. The primary take reduction measures of the plan include closures and modification of fishing gear and practices to reduce the adverse impacts of entanglement. Since no changes were anticipated from the existing operations of these fisheries, no additional incidental take was anticipated or authorized in this Opinion.

(4) Other – Sea turtles entering coastal or inshore areas have been affected by entrainment in the cooling-water systems of electrical generating plants. At the St. Lucie nuclear power plant at Hutchinson Island, Florida, large numbers of green and loggerhead turtles have been captured in the seawater intake canal in the past several years. Annual capture levels from 1994-1997 have ranged from almost 200 to almost 700 green turtles and from about 150 to over 350 loggerheads. Almost all of the turtles are caught and released alive; NMFS estimates the survival rate at 98.5% or greater (see NMFS 1997e). Other power plants in New Jersey, south Florida, west Florida, and North Carolina have also reported low levels of sea turtle entrainment, but formal consultation on these plants' operations has only been completed for two plants in New Jersey (Public Service Gas and Electric, Salem/Hope Creek Nuclear Generating Station and Oyster Creek NGS). Takes of turtles at these NJ plants reached a high in the early 1990s, but the problem was resolved by removing ice barriers around the intakes when turtles were present in Delaware Bay. One or two shortnose sturgeon become impinged annually, although in most cases the fish have already been in advanced states of decomposition and likely were not killed by the plant structure itself.

b. State or private actions

(1) *Private and commercial vessels*
Private and commercial vessels operate in the action area of this consultation and also have the potential to interact with whales and sea turtles. For example, shipping traffic in Massachusetts Bay is estimated at 1,200 ship crossings per year with an average of three per day. More than 280 commercial fishing vessels fish on Stellwagen Bank in the Gulf of Maine, and sportfishing contributes more than 20 vessels per day from May to September. Similar traffic may exist in many other areas within the scope of this consultation which overlap with whale high-use areas. The invention and popularization of new technology resulting in high speed catamarans for ferry services and whale watch vessels operating in congested coastal areas contributes to the potential for impacts from privately-operated vessels in the environmental baseline.

In addition to commercial traffic and recreational pursuits, private vessels participate in high speed marine events concentrated in the southeastern United States that are a particular threat to sea turtles. The magnitude of these marine events is not currently known. NMFS and the USCG are in early consultation on these events, but a thorough analysis has not been completed. The Sea Turtle Stranding and Salvage Network (STSSN) also reports many records of vessel interaction (propeller injury) with sea turtles off coastal states such as New Jersey and Florida, where there are high levels of vessel traffic.

(2) *State fishery operations*
Very little is known about the level of entanglement for sea turtles and shortnose sturgeon, serious injury or mortality of ESA-listed species in fisheries that operate strictly in state waters. However, depending on the fishery in question, many state permit holders also hold Federal licenses; therefore, section 7 consultations on Federal action in those fisheries address some state-water activity. Impacts of state fisheries on endangered whales are addressed as appropriate through the MMPA take reduction planning process. NMFS is actively participating in a cooperative effort with ASMFC to standardize and/or implement programs to collect information on level of effort and bycatch in state fisheries. When this information becomes available, it can be used to refine take reduction plan measures in state waters. With regard to whale entanglements, vessel identification is occasionally recovered from gear removed from entangled animals. With this information, it is possible to determine whether the gear was deployed by a Federal or state permit holder and whether the vessel was fishing in Federal or state waters. In 1998, 3 entanglements of humpback whales in state-water fisheries were documented.

In 1998, East Coast states from Maine through North Carolina began implementing regulations pursuant to the Year 1 requirements of *Amendment 3 to the Atlantic States Marine Fisheries Commission's Coastal Fishery Management Plan for American Lobster* (ASMFC 1997). The Federal ACFCMA plan is designed to be complementary to the ASMFC plan, and the two plans are largely similar in structure. Regulations will be geared toward reducing lobster fishing effort by 2005 to reverse the overfished status of the resource. States in the 6 coastal areas must implement regulations according to a compliance schedule established in Amendment 3. Effort reduction measures will be similar to those in the Federal ACFCMA plan. Several states have implemented trap caps for 1998. Further trap limits, which the compliance schedule requires for

Area 1 and the Outer Cape Lobster Management Area in 1999, will generate some localized risk reduction for protected species in those areas. If all states elect to implement a significant trap reduction program, the overall entanglement risk would be substantially reduced. As the Gulf of Maine and Mid-Atlantic lobster pot fisheries in the MMPA List of Fisheries (Section 118) includes state water effort, vessels fishing in state waters will be required to comply with MMPA take reduction plan regulations designed to reduce entanglement risk to whales.

Early in 1997, the *Commonwealth of Massachusetts* implemented restrictions on lobster pot gear in the state water portion of the Cape Cod Bay critical habitat during the January 1 - May 15 period to reduce the impact of the fishery on northern right whales. The regulations were revised prior to the 1998 season. State regulations impact state permit holders who also hold Federal permits, although effects would be similar to those resulting from Federal regulations during the January 1 - May 15 period. Massachusetts has also implemented winter/spring gillnet restrictions similar to those in the ALWTRP and the MSFCMA for the purpose of right whale and/or harbor porpoise conservation. Lobster pots are fished in areas outside of Massachusetts where sea turtles and the depleted stock of bottlenose dolphin are present. Entanglement has been documented for both species.

A Biological Opinion on the *NMFS/ASMFC interjurisdictional FMP for weakfish* was conducted in June 1997. Weakfish are caught in the summer flounder fishery and are also fished with flynets. Analyses of the NMFS' observer data showed 36 incidental captures of sea turtles for trawl and gillnet vessels operating south of Cape May, New Jersey from April 1994 through December 1996. Of those turtles taken, 28 loggerheads were taken in trawls that also caught weakfish and resulted in two deaths. Most of the sea turtle takes occurred in late fall. In all cases, weakfish landings were second in poundage behind Atlantic croaker and summer flounder (NEFSC, unpub. data).

The North Carolina Observer program documented 33 flynet trips from November through April of 1991 – 1994 and recorded no turtles caught in 218 hours of trawl effort. However, a NMFS observed vessel fished for summer flounder for 27 tows with an otter trawl equipped with a TED and then fished for weakfish and Atlantic croaker with a fly net that was not equipped with a TED. They caught one loggerhead in 27 TED equipped tows and seven loggerheads in nine fly net tows without TEDs. In addition, the same vessel using the fly net in a previous trip took 12 loggerheads in 11 out of 13 observed tows targeting Atlantic croaker. Weakfish was a secondary species from these fly net tows (NEFSC, unpub.data). A slight potential does exist for interaction between the bluefish fishery and humpback whales, particularly in the mid-Atlantic, but no documentation of such interactions is available.

<u>Other Southeast Fisheries</u>

Georgia and South Carolina prohibit gillnets for all but the shad fishery. This fishery was observed in South Carolina for one season by the NMFS Southeast Fisheries Science Center (McFee et al. 1996). No takes of protected species were observed. Florida has banned all but very small nets in state waters, as has the state of Texas. Louisiana, Mississippi and Alabama have also placed restrictions on gillnet fisheries within state waters such that very little commercial gillnetting takes place in southeast waters, with the exception of North Carolina.

Most pot fisheries in the southeast are prosecuted only in areas not likely to be frequented by whales.

c. Conservation and recovery actions shaping the environmental baseline

A number of activities are in progress that ameliorate some of the potential threat from the aforementioned activities. Education and outreach are considered one of the primary tools to reduce the threat of impact from private and commercial vessels. The USCG has provided education to mariners on whale protection measures and uses their programs such as radio broadcasts and notice to mariner publications to alert the public to potential whale concentration areas. The USCG is also participating in international activities (discussed below) to decrease the potential for commercial ships to strike a whale. In addition, outreach efforts for fishermen under the ALWTRP are increasing awareness and fostering a conservation ethic among fishermen that is expected in the long run to help reduce overall probability of adverse impacts in the environmental baseline from these commercial fishing activities.

In addition to the ESA measures for Federal actions mentioned in the previous section, numerous recovery activities are being implemented to decrease the level of impacts from private and commercial vessels in the action area. These include the early warning system (EWS), other activities recommended by the Northeast Recovery Plan Implementation Team for the Right and Humpback Whale Recovery Plans (NEIT) and Southeast Recovery Plan Implementation Team for the Right Whale Recovery Plan (SEIT), and NMFS regulations.

(1) The Northeast and Southeast Early Warning Systems

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Due to concern over potential collisions between right whales and hopper dredges operating in what is now designated critical habitat for right whales in southeast waters, monitoring requirements placed on the ACOE under a Biological Opinion resulted, in the 1980's, in the first regular aerial survey flights for right whales in waters off the Southeast United States. These surveys evolved over the years and, since late 1993/early 1994, have been officially sponsored by NMFS, the USCG, USN, and ACOE, and became known as the "Early Warning System" or EWS, also known as Whale Alert Program. The surveys were designed as daily reconnaissance flights to detect the presence of whales in and around a number of busy southeast shipping ports, USN vessel and submarine bases, and ACOE dredging sites, in order to alert vessels of the whales' presence and prevent potential whale/vessel collisions. The EWS, with the assistance of the USN and USCG, has evolved a sophisticated communication network which alerts not only dredges and military vessels in the area, but provides broadcasts to mariners via NAVTEX, NOAA Weather Radio, and other means, and even contacts vessels directly via radio when urgently necessary to prevent imminent collision.

Using the SEUS aircraft survey program as a model, efforts were initiated in 1997 to develop a similar program in the Cape Cod Bay (CCB) and the Great South Channel in late winter and early spring. The program is a cooperative effort by NMFS, the USCG, Massachusetts Division of Fisheries, the Massachusetts Environmental Trust, the Center for Coastal Studies, the USN and MASSPORT (the Boston port authority). As a result of recommendations by the ALWTRT, a similar EWS was established in the northeast in late 1996. NMFS has the ability under the ESA to impose emergency regulations which may be used to protect unusual congregations of right whales. Through a fax-on-demand system, fishermen can obtain EWS sighting reports and, in some cases, can make necessary adjustments in fishing practices to decrease the potential for entanglements. The Commonwealth of Massachusetts was a key collaborator in the 1996-1997 EWS effort and expanded the effort during the 1997-1998 seasons. Effort remained strong in 1999. The USCG has played a key role in this effort all along, providing both air and sea support, and their continued cooperation is expected throughout. The State of Maine and Canada Department of Fisheries and Oceans have expressed interest in conducting this type of EWS along their coastal waters. It is expected that other potential sources of sightings such as the U.S. Navy may contribute to this effort following NMFS' commitment to support the EWS over the long-term. The NMFS Maine ALWTRP Coordinator is also working with local aquaria to collect whale sightings from fishing vessels in the Gulf of Maine. All this cooperation will increase the chance of success of this program in diverting potential impacts in the environmental baseline.

(2) The Northeast and Southeast Whale Recovery Implementation Teams

In order to address the known impacts to right and humpback whales described in the Recovery Plans, NMFS established the Northeast and Southeast Recovery Plan Implementation Teams (NEIT and SEIT). The Recovery Plans describe steps to reduce the impacts to levels that will allow the two species to recover and rank the various recovery actions in order of importance. The Implementation Teams provide advice to the various Federal and state agencies or private entities on achieving these national goals within their respective regions. The teams both agreed to focus primarily on habitat and vessel- related issues and rely on the take reduction plan process under the MMPA for reducing takes in commercial fisheries.

As part of NEIT activities, a Ship Strike Workshop was held in April 1997 to inform the shipping community of their need to participate in efforts to reduce the impacts of commercial vessel traffic on northern right whales. The workshop summarized current research efforts using new shipboard and moored technologies as deterrents, and a report was given on ship design studies currently being conducted by the New England Aquarium and Massachusetts Institute of Technology. This workshop increased awareness among the shipping community and has likely further contributed to reducing the threat of ship strikes of right whales by advising mariners of information on location of whales so that they can be avoided (SAS) and by giving them guidance on operations when whales are encountered.. In addition, a Cape Cod Canal Tide Chart that included information on critical habitat areas and the need for close watch during peak right whale activity was distributed widely to professional mariners and ships passing through the canal. Annually, radio warning transmissions are transmitted by Canal traffic managers to vessels transiting the Canal during peak Northern right whale activity periods. Follow-up meetings were held with New England Port Authority and pilots to notify commercial ship traffic to keep a close watch during peak right whale movement periods. In response to current needs, the NEIT is reconfiguring its ship strike subcommittee to address these impacts on a more formal basis.

As part of addressing shipping issues on a more formal basis, the NEIT ship strike subcommittee developed a 1998-1999 strategy plan based on recommendations of a New England Aquarium shipping and right whale workshop in April of 1997. Language was developed for the U.S. Coast Pilot and NOAA nautical charts, a right whale brochure, and an International Maritime Organization (IMO) ship strike information paper, including language that eventually was used in development of the IMO initiative (see below). Even a recreational vessel initiative was put forward and a sticker warning operators of the potential for collision was developed. A right whale avoidance/training/education video targeting merchant mariners is in development. All these activities are aimed at educating all sectors of vessel operators from commercial merchants to recreational vessel owners. This NEIT ship strike subcommittee is also called on to address and suggest solutions to new issues as they arise, including the increase in high speed ferry services, so that they do not add impacts to the environmental baseline beyond what is already being considered.

Both the SEIT and NEIT's are involved in exploring a predictive GIS modeling system that will link environmental variables in key habitat areas to use as a management tool related to ship traffic in major shipping lanes near critical habitats. A workshop was held at the NEFSC in the fall of 1998 to begin the process of studying the linkage between environmental variables and right whale distribution. The SEIT has established a GIS subcommittee and is progressing with work to analyze right whale sightings, vessel traffic information, and pertinent environmental data in order to better understand right whale distribution patterns in southeast waters and ultimately prevent human interactions with these whales.

As of May 1999, a joint effort has begun to develop a cooperative program between shipping companies operating in the east coast coastal waters of Canada and the US. This will entail development of cooperative agreements between individual shipping companies.

(3) Reducing Potential for Vessel Related Impacts

As part of recovery actions aimed at reducing vessel related impacts, NMFS published a proposed rule in August 1996 restricting vessel approach to right whales (61 FR 41116) to distances outside of 500 yards in order to minimize human-induced disturbance. The Recovery Plan for the Northern Right Whale identified disturbance as one of the principal human-related factors impeding right whale recovery (NMFS 1991b). Following public comment, NMFS published an interim final rule in February 1997 codifying the regulations. With certain exceptions, the rules prohibit both boats and aircraft from approaching any right whale closer than 500 yds. The regulations are consistent with the Commonwealth of Massachusetts' approach regulations for right whales. These are expected to reduce the potential for vessel collisions inherent in the environmental baseline.

In April 1998, the USCG submitted, on behalf of the United States, a proposal to the International Maritime Organization (IMO) requesting approval of a mandatory ship reporting system in two areas off the east coast of the United States. The USCG worked closely with NMFS and other agencies on technical aspects of the proposal. The proposal was submitted to the IMO's Subcommittee on Safety and Navigation for consideration and submission to the

Marine Safety Committee at IMO and approved in December 1998. The system will require all vessels over 300 tons to report to a shore-based station, thereby prompting a return message which provides precautionary measures to be taken to reduce the likelihood of a ship strike and locations of recent right whale sightings. The reporting system will be implemented by July 1999. The USCG and NOAA will play important roles in helping implement the system.

(4) Measures to Reduce Incidental Takes of Sea Turtles in Commercial Fisheries

NMFS has implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial fisheries. In particular, NMFS has required the use of TEDs in southeast U.S. shrimp trawls since 1989 and in summer flounder trawls in the mid-Atlantic area (south of Cape Henry, Virginia) since 1992. It has been estimated that TEDs exclude 97% of the turtles caught in such trawls. These regulations have been refined over the years to ensure that TED effectiveness is maximized through proper placement and installation, configuration (e.g., width of bar spacing), flotation, and more widespread use. However, with the expansion of fisheries to previously underutilized species of fish, trawl effort directed at other than summer flounder and that does not meet the definition of a summer flounder trawl as specified in the TED regulations, may be an undocumented source of mortality for which TEDs should be considered.

In 1993 (with a final rule implemented 1995), NMFS established a Leatherback Conservation Zone to restrict shrimp trawl activities from off the coast of Cape Canaveral, Florida, to the North Carolina/Virginia border. This provides for short-term closures when high concentrations of normally pelagically distributed leatherbacks are recorded in more coastal waters where the shrimp fleet operates. This measure is necessary because, due to their size, adult leatherbacks are larger than the escape openings of most NMFS-approved TEDs.

In addition, NMFS has been active in public outreach efforts to educate fishermen regarding sea turtle handling and resuscitation techniques. As well as making this information widely available to all fishermen, over the past year NMFS has conducted workshops with longline fishermen to discuss bycatch issues including protected species, and to educate them regarding handling and release guidelines. NMFS intends to continue these outreach efforts and hopes to reach all fishermen participating in the pelagic longline fishery over the next one to two years.

(5) Sea Turtle Stranding and Salvage Network Activities

There is an extensive network of sea turtle stranding and salvage network (STSSN) participants along the Atlantic and Gulf of Mexico coasts which not only collects data on dead sea turtles, but also rescues and rehabilitates any live stranded turtles. In most states, the STSSN is coordinated by state wildlife agency staff, although some state stranding coordinators are associated with academic institutions. Data collected by the STSSN are used to monitor stranding levels and compare them with fishing activity in order to determine whether additional restrictions on fishing activities are needed. These data are also used to monitor incidence of disease, study toxicology and contaminants, and conduct genetic studies to determine population structure. All of the states that participate in the STSSN are collecting tissue for and/or conducting genetic studies to better understand the population dynamics of the small subpopulation of northern nesting loggerheads. These states also tag turtles as live ones are encountered (either via the stranding network through incidental takes or in-water studies). Tagging studies help provide an understanding of sea turtle movements, longevity, reproductive patterns, etc.

d. Other potential sources of impacts in the environmental baseline

A number of activities that may indirectly affect listed species in the action area of this consultation include discharges from wastewater systems, dredging, ocean dumping and disposal, and aquaculture. The impacts from these activities are difficult to measure. Where possible, however, conservation actions are being implemented to monitor or study impacts from these sources. For example, extensive monitoring is being required for a major discharge in Massachusetts Bay (Massachusetts Water Resources Authority) in order to detect any changes in habitat parameters associated with this discharge. MWRA participates in the NEIT and they are now developing a scope of work that will result in creation of a food web model for Massachusetts Bay as a requirement of their EPA permit. Close coordination is occurring through the section 7 process on both dredging and disposal sites to develop monitoring programs and ensure that vessel operators do not contribute to vessel-related impacts and that dredging is planned to reduce the potential for take of sea turtles.

NMFS and the U.S. Navy have been working cooperatively to establish a policy for monitoring and managing *Acoustic Impacts from Anthropogenic Sound Sources* in the marine environment. Acoustic impacts can include temporary or permanent injury, habitat exclusion, habituation, and disruption of other normal behavior patterns. It is expected that the policy on managing anthropogenic sound in the oceans will provide guidance for programs such as the use of acoustic deterrent devices in reducing marine mammal-fishery interactions and review of Federal activities and permits for research involving acoustic activities. The Office of Naval Research hosted a meeting in March 1997 to develop scientific and technical background for use in policy preparation. NMFS hosted a workshop in September 1998 to gather technical information which will support development of new acoustic criteria.

Aquaculture is currently not concentrated in whale, sturgeon, or sea turtle high-use areas, but some projects have begun in Cape Cod Bay Critical Habitat and in other inshore areas off the Massachusetts and New Hampshire coast. Acknowledging that the potential for impacts is currently unknown, NMFS is coordinating research to measure habitat related changes in Cape Cod Bay and is ensuring through the section 7 process that these facilities do not contribute to the entanglement potential in the baseline. Many applicants have agreed to alter the design of their facilities to minimize or eliminate the use of lines to the surface that may entangle whales and/or sea turtles.

The *Massachusetts Environmental Trust and Massachusetts Division of Marine Fisheries* have funded several projects to investigate fixed fishing gear and potential modifications to reduce the risk of entanglement to whales. These projects are an important complement to the NMFS research effort and have yielded valuable information on the entanglement problem. The Trust has also funded research on right whales in the Cape Cod Bay critical habitat area.

In summary, the potential for vessels and fisheries to adversely affect whales, sea turtles, and shortnose sturgeon remains throughout the action area of this consultation. However, recovery actions have been undertaken as described and continue to evolve. Although those actions have not been in place long enough for a detectable change in the northern right whale population (or other listed species populations) to have occurred, those actions are expected to benefit the northern right whale and other listed species in the foreseeable future. These actions should not only improve conditions for listed whale and sea turtles, they are expected to reduce sources of human-induced mortality as well.

E. Effects of the Action

This section of a BO assesses the direct and indirect effects of the proposed action on threatened and endangered species or critical habitat, together with the effects of other activities that are interrelated or interdependent (50 CFR 402.02). Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR 402.02).

Compared to other Atlantic trawl and gillnet fisheries the commercial bluefish fishery is relatively low in total landings; bluefish and is more often bycatch associated with other target fisheries in the EEZ than a target species of a directed fishery. As mentioned earlier, the directed commercial bluefish fishery is primarily in state waters, with the exception of New England where the majority of landings come from the EEZ. In general, mid-Atlantic landings predominate over northern and southern Atlantic regions. Therefore, **spatially**, the greatest interactions with this fishery and ESA-listed species would be expected to involve entanglement, capture, or hooking of sea turtles in state waters, primarily in the mid-Atlantic. In New England, gear that lands bluefish in the EEZ may also entangle large whales. The time of year that would be expected to result in the greatest number of interactions would be in the Mid-Atlantic from spring through fall. However, some interactions could occur in some regions as landings occur in every month though often associated with catches of other finfish fisheries. These interactions would also likely have already been considered in assessing impacts of other directed fisheries through consultations on species such as weakfish and summer flounder.

For the more southern states (SC, GA, FL), interactions are less likely in both gillnet and trawl gear. These states have banned most gillnetting in state waters. In addition, Turtle Excluder Device (TED) regulations are in place for summer flounder trawl vessels in parts of Virginia and North Carolina waters when trawlers are most capable of catching sea turtles. These TEDs have been shown to significantly reduce the mortality and serious injury of sea turtles taken in trawlers. Since the regulations require that any vessel capable of catching summer flounder or having 100 lbs or more of summer flounder on board are required to use TEDs, bluefish trawlers should fall under that definition.

Interactions with this fishery can take the form of entanglement, capture or hooking (internally or externally). Entanglement of marine mammals, sea turtles and shortnose sturgeon in gillnets is probably the most severe interaction as it most often results in serious injury and death. Animals that do escape often retain pieces of gear that can inhibit their foraging or other survival activities. The disentanglement network for large whales often successfully disentangles whales, but if sea conditions are not favorable or the whale is too mobile, efforts can be hampered; gear left trailing on the animal can cause later harm. The use of TEDs in trawls and the length of the tows influence the level of injury to sea turtles. For all the gear types it is often difficult for an observer to tell if an animal released alive has been injured to the point of influencing its future survival potential. Consequently, since most data on interaction with gear cannot be refined to further detail with respect to level of effect as described above, the term "take" is sometimes used in this discussion to refer to these different types of potential interactions with bluefish gear.

Given all these considerations, the primary species likely to be adversely affected by the commercial bluefish fishery would be loggerhead and Kemp's ridley sea turtles. Sea sampling data indicate very little interaction of mid-Atlantic fisheries with shortnose sturgeon and green sea turtles. The primary area of impact of the directed commercial fishery for bluefish on sea turtles is likely to be trawl and gillnet gear in state waters in the mid-Atlantic from Virginia through New York, from late spring through fall (peak bluefish abundance July - Oct). In New England, interactions with trawl and gillnet gear may occur in summer through early fall (peak bluefish abundance Aug-Sept), although given the level of effort, the probability of interactions is much lower than in the Mid-Atlantic.

Analysis of the existing observer data indicates that there have been very few observed trips that were targeting bluefish. Bluefish trips represented only 5% of all the gillnet trips observed (which in turn is only 5% of total trips prosecuted). In 1995--15 bluefish trips out of 398 trips were observed, in 1996--23/360, and in 1997--21/346. There were no entanglements of endangered species observed in bluefish gillnets on any of these trips. Harbor seals were the only species documented by observers entangled in bluefish gillnet gear on two trips where greater than 50% of the catch was bluefish. The remaining catch composition was primarily spiny dogfish. No captures or entanglements have been observed in trawls targeting bluefish.

The "OBSCON" data base (most recent, not completely verified data) showed the following information for trips where the secondary species (in terms of pounds kept) was bluefish:

date	kept catch composition	target fish	area	turtle species	condition
3/98	monkfish 2500 bluefish 72 summer fldr 13 Little tunny 10	monkfish	NC	loggerhead	alive
4/98	Kingfish 210 Bluefish 45 butterfish 6 bonito 5	kingfish	NC	Kemp's ridley	dead

date	kept catch composition	target fish	area	turtle species	condition
12/98	speck. trout 26 bluefish 16 mullet 6 weakfish 4 black drum 5 striped bass 2	speckled trout	NC	Kemp's ridley	injured, brought in for rehab
3/99	monkfish 8220 bluefish 520 little tunny 48	monkfish	NC	loggerhead	4 dead 1 alive
3/99	monkfish 2540 bluefish 80 black drum 40 little tunny 12	monkfish	NC	loggerhead	2 dead 1 alive

Generally it appears that bluefish are caught with a variety of other species depending on the season. While in the mid-Atlantic bluefish is consistently one of the top 5 species landed, it is usually not the target species since the market price is consistently very low (Tork, pers comm). However, based on the information above, the commercial fishery which catches and sells bluefish is taking Kemp's ridley and loggerhead sea turtles. Some of these interactions with gillnet gear have been analyzed in other consultations on FMPs like summer flounder and monkfish, but others, such as incidental takes during kingfish or speckled trout trips, would be unaccounted for. This indicates that adequate observer coverage needs to be maintained in the mid-Atlantic coastal gillnet fishery to cover fisheries like the bluefish fishery that use gear capable of entangling or capturing sea turtles in order to verify the extent of incidental take. The mid-Atlantic gillnet fishery, regardless of target species, is known to take sea turtles.

Very little data are available on the bluefish commercial fishery in the NMFS sea sampling database, but there is limited information on fisheries for similar species such as weakfish. As with weakfish, bluefish feed on small, schooling, pelagic fishes which also associates them in the water column with piscivorous whales. A consultation on the weakfish fishery (June 17, 1997), concluded that the weakfish fishery takes sea turtles. Flynet trawl gear indicated a particularly large take level. The biological opinion recommended a TED that would be workable in flynet trawls. In-water testing is scheduled for summer 1999. No information indicates that bluefish are targeted using this type of gear, although bluefish may be a portion of catch in many cases.

Adverse effects in the Mid Atlantic portion of the fishery.....
Comparing weakfish/Atlantic croaker information which is the most similar mid-Atlantic fishery to bluefish for which we have information, data in the NEFSC sea sampling data base from April 1994 - December 1996 showed no captures or entanglements of sea turtles in gillnets targeting weakfish or which contained weakfish in the catch (64 trips, 412 sets). Trawl trips that were targeting Atlantic croaker that also contained weakfish and summer flounder had incidental takes of turtles. This is the same type of gear used to target bluefish. During the times sea turtles are present in the area being fished, bluefish trawls are just as capable of taking turtles. The number of trips sampled for either bluefish or weakfish are inadequate to draw any statistical conclusions or estimate total expected take. In 1999, mid-Atlantic coastal trawl trips in January recorded 12 loggerhead turtles, 2 Kemp's ridleys, and one unidentified turtle; in February three loggerheads

were observed taken. In March 1999, nine loggerheads and one Kemp's ridley were taken in bottom coastal gillnets. While these were not bluefish-directed trips, this information illustrates how capable the gear is of taking turtles. Take patterns logically follow the seasonal nature of both the fisheries and the sea turtles. Takes are more prevalent in North Carolina in the late winter and in New England during summer.

For endangered whales, the most likely species that may interact with this portion of the fishery include humpback and fin whales in the fall/winter in the Mid-Atlantic. As mentioned in the status of listed species section above, juvenile humpbacks have shown an increased inshore presence in the mid-Atlantic waters in the fall and winter months in recent years.

Shortnose sturgeon are found in the Hudson, Delaware and Chesapeake River systems. It is possible that shortnose sturgeon could be taken in the estuaries of these systems, although observer information is considered inconclusive due to the difficulty in differentiating this species from the Atlantic sturgeon. However, sturgeon are usually found in the estuaries in winter and upstream during spring through fall, which is not when most of the bluefish fishing takes place.

Adverse effects in the New England component of the fishery:
In contrast to the mid-Atlantic discussed above, most New England landings of bluefish in the commercial fishery are from effort in the EEZ. In the Gulf of Maine EEZ, the fishery would not only be likely to adversely affect Kemp's ridley, loggerhead and leatherback sea turtles, but would also have more potential to come into contact with large whales: right whales, humpback whales and fin whales. Since the gillnets used in the bluefish fishery would need to comply with both the ALWTRP and the HPTRP, which are part of the scope of the action considered in this consultation, and since the ALWTRP is expected to reduce the serious injury and mortality of these species of large whales to below the potential biological removal level, the effects of the bluefish fishery on large whales should be minimal. This is particularly true, given low overall effort for bluefish in New England, which means there is a low probability that this fishery will actually interact with large whales.

As far as trawls are concerned, New England trawl gear does not use TEDs and sea turtles are taken in finfish trawls in New England as demonstrated above. However, the expected take in New England would be much lower than in the mid-Atlantic because overall effort is very low and the density of sea turtles is lower as well.

Since the New England portion of this fishery is primarily in the EEZ, it is unlikely that shortnose sturgeon would be taken in this fishery. While these fish are known to make occasional excursions into the saline environment, they primarily occupy the upper estuaries and rivers. However, due to the difficulty in differentiating this species from the Atlantic sturgeon, observer and logbook data are inconclusive. Some takes of shortnose sturgeon have been recorded and consequently cannot be ruled out entirely. As with the mid-Atlantic, the fish are found in the lower reaches of rivers and estuaries primarily during winter, and are further upstream, away form the EEZ area of operation for the bluefish fishery during summer on New England.

Adverse affects in the southeast component of the fishery:
As with the New England and mid-Atlantic portions of this fishery, bluefish is often a secondary target species in the southeast. Fishermen in the Spanish mackerel fishery are known to target bluefish when they cannot target Spanish mackerel. Pompano and spot fisheries, also subsets of the Spanish mackerel fishery also often target bluefish as a secondary species in southern Georgia and Florida (FDEP unpublished data). Gillnets are banned in state waters in the southeast, but gillnet effort could occur in the EEZ and trawlers can operate throughout the area. However, trawlers in North Carolina are required to use TEDs if they meet the definition of a summer flounder trawler (capable of catching summer flounder or having 100 pounds or more of summer flounder on board).

Shortnose sturgeon are found in rivers in North Carolina and Georgia (Cape Fear River, Savannah and Santee Rivers), but as in the northeast and mid-Atlantic rivers tend to occupy the estuarine environment during late fall and winter and move upriver to spawn in spring. While it is possible for the range of the species and the fishery to overlap in this region, the probability of an entanglement or capture occurring is very low.

The bluefish fishery would be expected to have the least impact on sea turtles and shortnose sturgeon in the southeast and will likely not interact with any endangered whales. This is because effort for bluefish is comparatively low overall in the southeast compared to the other two regions, turtles are protected from trawlers in this fishery by TEDs in North Carolina (based on their meeting the summer flounder definition), and gillnets are banned in South Carolina, Georgia and Florida state waters.

Other commercial gear types: As noted earlier, fish pound nets (7%), hand and troll lines (6%), and haul seines (3%) are used in the commercial bluefish fishery. Sea turtles are found inside pound nets and can become entangled in the leaders. Smaller marine mammals are known to be taken in haul seines but no entanglements have been documented for sea turtles. Hand and troll lines have been implicated by anecdotal accounts as snagging endangered whales, but no injury was expected a a result. Since this fishery is so small to begin with and these gear types represent such a small proportion of total effort, it is unlikely that entanglement or capture in this type of gear would occur for any ESA-listed species.

Recreational Fishery

Since the recreational fishery gets 80% of the bluefish quota and charter/recreational boats are commonly found in the EEZ, a significant amount of hook and line fishing occurs for bluefish.

Sea turtles do ingest baited hooks or get snagged in their appendages by hooks, both of which have been recorded in the STSSN database. The probability of this occurring is difficult to ascertain and very little data are available to analyze impacts from this type of interaction on individual animals. In a study conducted by NMFS Galveston Laboratory between 1993 through 1995 (Cannon and Flanagan, 1996), interactions of 170 Kemp's ridleys were reported associated with recreational hook and line gear:

18 dead stranded turtles

51 rehabilitated turtles
5 that died during rehabilitation
96 released by fishermen

Cumulatively, fishery entanglement anomolies are noted in fewer than 4% of stranded sea turtle carcasses reported between 1990 and 1996 and some carcasses carry more than one hook (NMFS Biological Opinion on Brunswick Steam Electric Plant). In addition it is often impossible to tell if the entangling gear is recreational or commercial.

Summary: Based on the discussion above, including analysis of observer data and comparison to similar fisheries, the commercial bluefish fishery is likely to have its greatest effect on loggerhead and Kemp's ridley sea turtles in the mid-Atlantic area from spring through fall. This commercial fishery is somewhat unique in that, due to low market value, relatively few fishermen target this species, but they represent an important secondary species in fisheries targeting other species in kept catch for commercial sale. Consequently, some of the incidental take related to commercial bluefish catch has been addressed in several other FMP consultations on the target species. However, some previously unaddressed sea turtle take is expected from both the commercial and recreational fishery targeting bluefish. Given the relatively low effort overall in the gillnet portion of this fishery, particularly in New England, and restrictions of the ALWTRP, the probability of interactions with endangered whales is small. Turtles may also be taken in trawls for bluefish, but trawl effort is even lower than gillnet effort and the total number of takes in trawls would be small.

Adverse effects on right whale critical habitat:

AP

There is no known direct trophic interaction between bluefish and right whales. However, recovery of commercially targeted finfish stocks from their current overfished condition may increase predation on the small schooling fish biomass (sand lance, herring, and mackerel) that do feed directly on zooplankton resources throughout the species' feeding range. In addition, it is unlikely that zooplankton densities that occur seasonally in Cape Cod Bay or the Great South Channel could be expected to increase significantly. However, increased predation by finfish on small schooling fish in certain areas and at specific critical periods may allow the necessary high zooplankton densities to be maintained in these areas for longer periods, or accumulate in other areas at adequate levels for right whale feeding.

No direct adverse effects on right whale critical habitat are expected from commercial or recreational gear for bluefish.

F. Cumulative Effects

"Cumulative Effects," as defined in the ESA, are "those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." Therefore, this section does not discuss the cumulative effects of Federal actions since these actions undergo section 7 consultations and are accounted for in the environmental baseline section of this opinion.

Cumulative impacts from unrelated, non-Federal actions occurring in the northwest Atlantic may affect sea turtles, marine mammals, and their habitats. Stranding data indicate that marine mammals and sea turtles in Atlantic waters die of various natural causes, including cold stunning (in the case of sea turtles), as well as human activities, such as incidental capture in state fisheries, ingestion of or entanglement in debris, vessel strikes, and degradation of nesting habitat. The cause of death of most marine mammals and turtles recovered by the stranding network is unknown. In waters of many Atlantic states, state-permitted coastal gillnetting may affect listed sea turtles and marine mammals. Recreational hook-and-line fisheries have been known to lethally take sea turtles, including Kemp's ridleys.

Fishing activities in state waters take several protected species. However, it is not clear to what extent state-water fisheries may affect listed species differently than the same fisheries operating in Federal waters. Further discussion on state water fisheries is contained in the Environmental Baseline section.

Wiley *et al.* (1995) showed that for stranded humpback whales where the cause of death was determinable, (mid-Atlantic area between Chesapeake Bay, Virginia, and Cape Hatteras, North Carolina) 30% of the mortalities were attributed to vessel strikes and 25% had injuries consistent with entanglement in fishing gear. This indicates that vessel interactions are having an impact upon whale populations along this portion of the coast, as well as in right whale concentration areas. Because most of the whales involved in these interactions are juveniles, areas of concentration for young or newborn animals are particularly important to protect. This also raises concerns that, with such mortality focused on one age-class of the population, that future recruitment to the breeding population may be affected.

Ship strikes have been identified as a significant source of mortality to the northern right whale population (Kraus 1990) and are also known to impact all other endangered whales. Small vessel traffic is also known to take sea turtles. Commercial and private vessels may affect humpback, fin and right whales, and all species of sea turtles. As a point of reference, commercial shipping traffic in Massachusetts Bay is estimated at 1200 ship crossings per year with an average of three per day. About 20 whale watch companies representing 40–50 boats conduct several thousand trips from April to September, with the majority of effort in the summer season. More than 280 commercial vessels fish on Stellwagen Bank. Sportfishing contributes more than 20 vessels per day from May to September. In addition, an unknown number of private recreational boaters frequent Massachusetts and Cape Cod Bays. Massachusetts waters occupy only a small portion of the range of these species, so the potential traffic they are subjected to over their entire range along the western N. Atlantic is substantial. It is possible that the combination of these activities may cause sublethal effects to protected species that could prevent or slow a species' recovery. While the combination of these activities may cause sublethal effects to endangered and threatened species that could prevent or slow a species' recovery, such effects are currently unknown. Various initiatives have been planned or undertaken to expand or establish high-speed watercraft service in the northwest Atlantic, including one service between Bar Harbor, Maine, and Nova Scotia with a vessel operating at higher speeds than established watercraft service. The Bar Harbor–Nova Scotia high speed ferry conducted its first season of operations in 1998. The operations of these vessels and other high-speed craft may adversely affect threatened and endangered whales and sea turtles, as discussed previously with private and commercial vessel traffic in the Action Area. NMFS and other member agencies of the NEIT will continue to monitor the development of the high speed vessel industry and its potential threats to listed species and critical habitat. Recent whale strikes resulting from interaction with whale watch boats and recreational vessels have also been recorded.

It is expected that states will continue to license/permit large vessel and thrill-craft operations which do not fall under the purview of a Federal agency and will issue regulations that will affect fishery activities. NMFS will continue to work with states to develop ESA Section 6 agreements and Section 10 permits to enhance programs to quantify and mitigate these takes. Increased recreational vessel activity in waters of the Atlantic and Gulf of Mexico will likely increase the number of whales and turtles taken by injury or mortality in vessel collisions.

Sources of pollutants in Atlantic and Gulf coastal regions include atmospheric loading of pollutants such as PCBs, storm water runoff from coastal towns, cities and villages, runoff into rivers emptying into the bays, groundwater discharges and river input and runoff. Nutrient loading from land based sources such as coastal community discharges is known to stimulate plankton blooms in closed or semi-closed estuarine systems. The effects to larger embayments is unknown. Although pathological effects of oil spills have been documented in laboratory studies of marine mammals and sea turtles (Vargo *et al.* 1986), the impacts of many other anthropogenic toxins have not been investigated.

Geraci *et al.* (1989) identified bioaccumulation of the neurotoxin responsible for paralytic shellfish poisoning (saxitoxin) in mackerel consumed by humpback whales as the possible cause of mortality of 14 humpbacks which stranded between November of 1987 and January of 1988. No saxitoxin was identified in plankton or shellfish sampled in Massachusetts waters at the time of the mortality. The authors suggest the neurotoxin could have been transported by mackerel obtaining the toxin from planktonic sources in the Gulf of St. Lawrence, the spawning ground for mackerel. While a similar multiple mortality of large whales has not been observed, the authors suggest individual mortalities caused by the biotoxin would go unnoticed. The reason for the multiple mortalities in the winter of 1987 and 1988 was never explained, although they may have been related to a shift in the normal diet of humpbacks due to the lack of sand lance in the bays the previous summer.

Other contributors of pollutants in the Massachusetts and Cape Cod Bays include atmospheric loading of pollutants such as PCBs, storm water runoff from Massachusetts coastal towns, cities and villages, runoff into rivers emptying into the bays, groundwater discharges and river input and runoff from Gulf of Maine waters.

Generally, right whales and humpback whales do not use southeastern waters for feeding. Therefore, most of the effects from pollution would be expected in the northern summer feeding areas for these species. However, sea turtles nest primarily in the southeastern United States, and early life stages and breeding individuals of these species are likely to be impacted by pollution in these areas, as well as in the northeast. Necropsies of hatchlings and juveniles show that young turtles commonly consume plastics and tar balls (STSSN stranding data base).

Humpback whale entanglements occur in relatively high numbers in Canadian waters. Reports of collisions with fixed fishing gear set for groundfish around Newfoundland averaged 365 annually from 1979 to 1987 (range 174–813). An average of 50 humpback whale entanglements (range 26–66) were reported annually between 1979 and 1988 and 12 of 66 humpback whales that were entangled in 1988 died (Lien *et al.*, 1988). Right whale entanglements also occur in Canadian waters, although not as frequently as for humpback whales. Many entanglements observed in U.S. waters may have originated in Canadian waters. Unless gear is specifically marked and such marks are documented, it is often impossible to determine the origin of the gear.

For sea turtles, substantial impacts of human activities are still evident on nesting populations of all species, particularly those areas outside of U.S. control. This includes poaching of eggs from nests and using the turtles themselves for food or shell products.

The combination of all these activities may cause effects to protected species that could prevent or slow a species' recovery. Designation of critical habitat, proactive approaches by other Federal agencies (i.e. the Army Corps of Engineers (ACOE) has limited dredging in southeastern channels to periods when turtles are not concentrated in the channels), participation by Federal agencies in recovery plan implementation activities and the section 7 process all contribute to mitigating these potential cumulative effects.

G. Conclusion

AO

After reviewing the current status of listed species, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the NMFS' biological opinion that the operation of the recreational and commercial bluefish fishery and associated management actions are not likely to jeopardize the continued existence of right, humpback and fin whales, or loggerhead, Kemp's ridley, or leatherback sea turtles, or shortnose sturgeon, and is not likely to adversely modify right whale critical habitat.

H. Incidental Take Statement

Section 9 of the Endangered Species Act and federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Incidental take is defined as take that is incidental to, and not the purpose of, the execution of an otherwise lawful activity. Under the terms of sections 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS).

The measures described below are non-discretionary and must be undertaken by NMFS in a manner that they become binding conditions so that the exemption in section 7(o)(2) will apply. NMFS has a continuing duty to regulate the activity covered by this ITS. If NMFS fails to assume and implement the terms and conditions through enforceable terms, the protective coverage of section 7(o)(2) may lapse. In addition, NMFS must report the progress of the action and monitor the impact of incidental take.

When a proposed NMFS action which may incidentally take individuals of a listed species is found to be consistent with section 7(a)(2) of the ESA, section 7(b)(4) of the ESA requires NMFS to issue a statement specifying the impact of any incidental taking. It also states that reasonable and prudent measures necessary to minimize such impacts be provided along with implementing terms and conditions. Only those incidental takes resulting from the agency action (including those caused by activities approved by the agency) that are identified in this statement and are in compliance with the specified reasonable and prudent alternatives and terms and conditions are exempt from the takings prohibition of section 9(a), pursuant to section 7(o) of the ESA.

NMFS is not including an incidental take authorization for endangered whales at this time because the incidental take of endangered whales currently cannot be authorized under the provisions of section 101(a)(5) of the Marine Mammal Protection Act or its 1994 Amendments.

Anticipated Amount or Extent of Incidental Take

NMFS anticipates that the operation of the bluefish fishery under the proposed Bluefish FMP may result in the injury or mortality of loggerhead or Kemp's ridley sea turtles and shortnose sturgeon by entanglement, capture or hooking. Based on observed takes from Sea Sampling data for gear types targeting or capable of catching bluefish, NMFS anticipates that the following numbers of incidental takes of sea turtles and shortnose sturgeon may be observed annually in the bluefish fishery:

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- 6 takes (no more than 3 lethal) of loggerhead sea turtles,
- 6 lethal or non-lethal take of Kemp's ridley sea turtles,
- 1 shortnose sturgeon

Effect of the take

In the accompanying Biological Opinion, NMFS has determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

Reasonable and Prudent Measures

Not more than 6 loggerhead sea turtles and 6 Kemp's ridley sea turtle are authorized to be incidentally taken in any given year as a result of the bluefish fishery. Below are the reasonable and prudent measures, with their implementing terms and conditions, that are designed to minimize the impact of the incidental take that might otherwise result from the proposed action. If, during the course of the bluefish fishery, this level of incidental take is exceeded, the additional level of take would represent new information requiring reinitiation of consultation and review of the reasonable and prudent measures that have been provided. If authorized levels of incidental take are exceeded, the Office of Sustainable Fisheries must immediately provide an explanation of the causes of the taking and review, with the Office of Protected Resources, the need for possible modification of the reasonable and prudent measures.

NMFS has determined that the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of sea turtles and shortnose sturgeon:

1. NMFS must provide for and evaluate observer information (and other information when available) annually to determine whether the incidental take level should be modified or if other management measures need to be implemented to reduce the take. Reports must be submitted to Northeast Region and Headquarters Protected Resources Divisions.

2. NMFS must incorporate planning for reporting of sea turtle takes into the Atlantic Coastal States Cooperative Statistics Program. Reporting information must provide adequate identification guidance for both sea turtles and shortnose sturgeon. Takes must be reported within 48 hours of returning from a trip in which an incidental take occurred. The reports shall include a description of the animal's condition at the time of release. NMFS shall incorporate this reporting requirement into the FMP.

3. Permit holders must be notified that when they are operating trawls in areas of North Carolina and Virginia when TEDs are required under 50 CFR §223.206(d)(2)(iii) that they are included in the definition of summer flounder trawls as vessels that are operating gear capable of catching summer flounder, and consequently cannot operate in those areas without properly installed TEDs.

AD

4. NMFS must provide the guidance such that any sea turtle incidentally taken will be handled with due care to prevent injury to live specimens, observed for activity, and returned to the water.

Terms and Conditions:

1. NMFS will send a letter by January 1, 2000. to all bluefish permit holders detailing the following:

A. protocol for handling a turtle interaction. This letter must include the following measures, which are provided in 50 CFR 223.206(d)(1):

1. Live animals must be handled with care and released as soon as possible without further injury.

2. Animals are to be released when the vessel is in neutral and only in areas where they are unlikely to be recaptured or injured by vessels.

3. Comatose sea turtles should be resuscitated according to the procedures set forth in 50 CFR 223.206(d)(2)(iii).

4. Dead sea turtles may not be consumed, sold, landed, offloaded, transshipped or kept below deck, but must be released over the stern of the vessel.

B. information on the requirement and timing for TED use in Virginia and North Carolina trawl gear per 50 CFR § 227.72 (2)(iii)

C. Outreach information on the ALWTRP and HPTRP requirements

3. NMFS will ensure that observer coverage in the Mid-Atlantic coastal trawl and gillnet observer programs includes bluefish directed trips and trips where the secondary catch is bluefish. An annual summary of sea turtle takes in bluefish directed trips an in trips where the secondary catch is bluefish will be provided to the Northeast Region Protected Resources Division to monitor this incidental take statement.

4. NMFS will conduct a survey of bluefish recreational fishermen to fully evaluate the impact of the recreational component on sea turtles.

5. NMFS will incorporate specific training on identification of shortnose and Atlantic sturgeon into observer training, including the intra-orbital width measurement method.

NMFS believes that no more than 6 loggerhead sea turtles and 6 Kemp's ridley sea turtles per annum will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Office of Sustainable Fisheries must immediately provide an explanation of the causes of the taking and review with the Office of Protected Resources the need for possible modification of the reasonable and prudent measures.

AD

I. Conservation Recommendations

In addition to section 7(a)(2) of the ESA, which requires agencies to ensure that proposed projects will not jeopardize the continued existence of listed species, section 7(a)(1) of the ESA places an additional responsibility on all federal agencies to ". . . utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species....". Conservation Recommendations are discretionary activities designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The conservation actions related to entanglement which were recommended in the Recovery Plans for the right and humpback whales are implemented in the Atlantic Large Whale Take Reduction Plan, which will also benefit other endangered whales. The following measures are recommended for sea turtles:

1. NMFS should continue to pursue efforts to work with states to develop section 10 permits and associated conservation plans that improve data collection regarding the incidental

take of sea turtles and reduction of takes. In this regard, NMFS should continue to pursue Section 6 Cooperative Agreements with states to better meet the conservation needs of sea turtles in state water fisheries, particularly in the mid-Atlantic.

2. NMFS, in conjunction with the ASMFC or other appropriate regulatory authority, should encourage states to require fishermen to report sea turtle takes as bycatch in any mandatory state logbooks and should provide instructions on release. Reports should include a description of the animal's condition at the time of release.

3. A significant amount of ghost gear is generated from fixed gear fisheries, occasionally due to conflict with mobile gear fisheries, other vessel traffic, storms, or oceanographic conditions. There is potential that this gear could adversely affect both sea turtles and their habitat. In order to minimize the risks associated with ghost gear, NMFS should assist the USCG in notifying all Atlantic fisheries permit holders of importance of bringing gear back to shore to be discarded properly. In conjunction with the USCG, fishery councils/commissions, and other appropriate parties, NMFS should review current regulations that concern fishing gear or fishing practices that may increase or decrease the amount of ghost gear to determine where action is necessary to minimize impacts of ghost gear. NMFS should assist the USCG in developing and implementing a program to encourage fishing industry and other marine operators to bring ghost gear in to port for re-use and recycling. In order to maximize effectiveness of gear marking programs, NMFS should work with the USCG and fishery councils/commissions to develop and implement a lost gear reporting system to tie in with ghost gear program and consider incorporating this system into future revisions of the appropriate management plans.

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In order for the Office of Protected Resources to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Office of Protected Resources requests notification of the implementation of any conservation recommendations.

J. Reinitiation of Consultation

This concludes formal consultation on the proposed Federal bluefish fishery. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered (specifically, should results of monitoring and reporting effort included as part of the ALWTRP provide new information that the levels of take are higher than expected or new fishing methods or gear are developed that will eliminate existing threats to endangered whales, consultation should be reinitiated); (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, NMFS' Office of Sustainable Fisheries must immediately request reinitiation of formal consultation.

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