Fishery Management Report No. 40

of the

Atlantic States Marine Fisheries Commission

Interstate Fishery Management Plan
For
Spiny Dogfish

November 2002

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Prepared by

Atlantic States Marine Fisheries Commission
Spiny Dogfish Plan Development Team

Plan Development Team Members:

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This Management Plan was prepared under the guidance of the Atlantic States Marine Fisheries Commission's Spiny Dogfish and Coastal Shark Management Board, Chaired by John Connell of New Jersey and Fentress Munden of the North Carolina Division of Marine Fisheries. Technical and advisory assistance was provided by the Spiny Dogfish Technical Committee and the Spiny Dogfish Advisory Panel.

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EXECUTIVE SUMMARY

1.0 Introduction

On April 3rd, 1998, National Marine Fisheries Service declared spiny dogfish overfished. Initial management actions to regulate the spiny dogfish fishery began in 1998 with the approval of a draft document called, "The Spiny Dogfish Fishery Management Plan" by the Mid-Atlantic Fishery Management Council (MAFMC) and the New England Fishery Management Council (NEFMC). The fishery management plan (FMP) was partially approved by the National Marine Fisheries Service (NMFS) on September 29, 1999, and the final rule implementing the FMP was published on January 10, 2000. The current federal FMP is based on a constant fishing mortality strategy that allows for low bycatch landings in the initial stages with increased landings as the female portion of the stock rebuilds (MAFMC and NEFMC, 1999). The federal FMP specifies a coastwide target fishing mortality rate of F = 0.03. This F target results in an initial quota of 4 million pounds. The annual quota is split on a semi-annual basis of Period I extending from May 1 through October 31, and Period II from November 1 through April 30. To control the level of effort, the management program also uses possession limits of 600 and 300 pounds for Period I and II, respectively.

Federal action was initiated as increased fishing effort was directed on the spiny dogfish stock, which was a result of the declining abundance of more traditional groundfish resources. With no restraint on the harvest of spiny dogfish in the U.S. EEZ, fishing effort increased and most of the effort was directed on the removal of the adult female component of the stocks. Ultimately, this resulted in National Marine Fisheries Service designating spiny dogfish as overfished on April 3rd, 1998. This action mandated the development of the federal management plan.

The semi-annual quota periods were designed to provide each state with an opportunity to land some quantity of spiny dogfish. However, due to the species' annual migratory pattern, the entire annual quota was taken during the first semi-annual period. As a result, the fishermen in states where the stocks are not available to them until the second harvest period were prohibited from landing spiny dogfish before they even had the opportunity to fish.

There was also concern that the industry infrastructure would disappear due to the low allowable catch limits, thereby eliminating any outlet for fishermen to land spiny dogfish caught as a bycatch in other fisheries or the possibility of restoring a directed fishery once the stock recovers. With out the necessary infrastructure to process the landings, the situation could result in increased discards and more waste while fishing.

The federal plan only regulated the practices of permitted fishermen harvesting in the EEZ. In August 2000, the Atlantic States Marine Fisheries Commission's (ASMFC) Spiny Dogfish and Coastal Shark Management Board took emergency action to close state waters to the commercial harvest, landing, and possession of spiny dogfish when federal waters are closed due to the fishery landing its quota. The intent of the Emergency Action was to: 1) prevent the overharvest of spiny dogfish, thereby reducing the risk of stock collapse; 2) prevent the unregulated portion of the spiny dogfish fishery in state waters from undermining the intent of the federal Spiny Dogfish Management Plan; and 3) provide time for ASMFC to develop an interstate spiny dogfish FMP which would provide a framework for managing the fishery in state waters.

The Spiny Dogfish Emergency Action was due to expire and could not be extended beyond January 31st, 2003 due to ASMFC's policies regarding emergency actions. Emergency actions are effective for 180 days from the date of the Board's declaration of an emergency, at which time the Board can extend the emergency action for two additional periods of up to one year each. The extensions can be made provided the Board has initiated action to prepare a fishery management plan. The ASMFC's Policy Board approved the development of an interstate fishery management plan for spiny dogfish on May 20, 1999. Approval of an interstate management plan for spiny dogfish (approved November 21, 2002) before the expiration of the Emergency Action (expires January 31, 2003) creates a seamless transition while maintaining coordinated management of the resource across state boundaries.

2.0 Goals, Objectives, Management Unit, Overfishing Definition

The goal of the Interstate Fishery Management Plan for Spiny Dogfish is to promote stock rebuilding and management of the spiny dogfish fishery in a manner that is biologically, economically, socially, and ecologically sound.

In support of this goal, the following objectives are recommended for the Spiny Dogfish Fishery Management Plan:

- Reduce fishing mortality and rebuild the spawning stock biomass to prevent recruitment failure and support a more sustainable fishery.
- Coordinate management activities between state, federal and Canadian waters to ensure complementary regulations throughout the species range.
- Minimize the regulatory discards and bycatch of spiny dogfish within state waters.
- Allocate the available resource in biologically sustainable manner that is equitable to all the fishers.
- Obtain biological and fishery related data from state waters to improve the spiny dogfish stock assessment that currently depends upon data from the federal bottom trawl survey.

Specification of Management Unit *(2.4)*
The management unit for the Spiny Dogfish Management Plan is defined the range of the spiny dogfish resource within the US waters of the Northwest Atlantic Ocean. Spiny dogfish are migratory species and range from Labrador to Florida. They are most abundant from Nova Scotia to Cape Hatteras. Spiny dogfish are considered a unit stock in the Northwest Atlantic Ocean. It is recognized that the spiny dogfish resource, as defined here, is interstate and state-federal in nature, and that effective assessment and management can be enhanced through cooperative efforts with all Atlantic state and federal scientists and fisheries managers.

The management area of this management plan shall be the entire coastwide distribution of the resource from the estuaries eastward to the inshore boundary of the EEZ.

Overfishing Definition *(2.5)*
The target and threshold fishing mortality rates are adopted from the federal spiny dogfish management plan (MAFMC and NEFMC, 1999). The threshold fishing mortality rate, $F_{rep} = 0.11$, allows for the production of one female pup per female that will recruit to the spawning stock biomass. The target fishing mortality rate, $F_{rep} = 0.082$, allows for the production 1.5 female pups per female recruit to the spawning stock biomass (Table 25). The threshold and target fishing mortality rates are conditioned on the assumption that the size at entry into the fishery is 27.5 inches (70 cm).

While the female portion of the spawning stock biomass is below the target and threshold SSB, the target fishing mortality rate will be set at 0.03. Setting a low fishing mortality rate allows the stock to rebuild to the level at or near 100% of SSB_{max}. An F of 0.03 is a short term fishing mortality rate applied for duration of the rebuilding period. The stock will be managed under the long term fishing mortality rate of 0.082 once the mature female portion of the spawning stock has reached the target.

Target Fishing Mortality Rates for Rebuilding and Recovered Stock Conditions and the Threshold Fishing Mortality Rate.

Target Fishing Mortality Rate (rebuilding period)	**0.03**
Target Fishing Mortality Rate (stock ≥ 100% SSB_{max})	**0.082**
Threshold Fishing Mortality Rate	**0.11**

The maximum spawning stock biomass (SSB_{max}) is a proxy for B_{msy} or the level of biomass that would maximize recruitment for the population. For the purposes of this management plan, the spawning stock biomass is the mature female portion of the total population. An overfished stock occurs when the adult female biomass falls below ½ the maximum spawning stock biomass (½ SSB_{max}). At the time this management was developed, the target female spawning stock biomass was estimated to be 167,000 mt or 100% SSB_{max}. This is the level of spawning stock biomass that would maximize the recruitment to the spiny dogfish population.

Stock Rebuilding Target *(2.6.1)*
The stock rebuilding target is defined by the female portion of the spawning stock biomass. The spiny dogfish spawning stock biomass is estimated from the NMFS spring bottom trawl survey and is calculated using survey units (kilograms per tow). Survey units, net dimensions, speed, duration of tow, catchability of the nets, as well as other parameters of the survey are used to estimate the area-swept biomass. Swept-area biomass is commonly used to describe the target and current spiny dogfish biomass (in metric tons) because it provides an easy comparison to the annual quota (in metric tons). The spawning stock biomass target, expressed as area-swept biomass, may change as modifications are made to calculating the area-swept by and catchability of the NMFS spring trawl survey. Recently, modifications were made to calculating the area-swept by the trawl survey. The table below shows the area-swept "old scaling" before re-estimating the parameters of the area covered by the trawl survey, as well as the area-swept using the "new scaling". The spawning stock biomass target in survey units (kilograms per tow) was not effected by the changes to the survey footprint or the efficiency of the trawl survey. The target is to rebuild the female portion of the spawning stock to 100% of the spawning stock biomass (SSB_{max}), which is currently estimated to be 167,000 metric tons.

Target biomass, minimum biomass thresholds, and current spawning stock biomass expressed in survey units, percentages, area swept (old scaling and new scaling). Numbers apply to the mature female portion of spawning stock biomass.

Female Spawning Stock Biomass (SSB)	Survey Units (kg/ tow)	Percentage of Target Biomass	Area swept "Old scaling"	Area Swept "New scaling"
Target Biomass (SSB_{max})	31.0 kg/tow	100%	200,000 mt	167,000 mt
Minimum Biomass Threshold (1/2 SSB_{max})	15.5 kg/tow	50%	100,000 mt	83,500 mt
Current SSB (mean 2000-2002)	13.5 kg/tow	44%	86,946 mt	72,600 mt

Stock Rebuilding Schedules *(2.6.2)*
Based on the different management strategies considered for this management plan and the life history characteristics of spiny dogfish, the rebuilding time may take as long as 15 to 20 years (Rago 2001). Due to the slow growth and low reproductive capabilities of spiny dogfish, a low fishing mortality rate will produce sustainable harvests in the long run. The rebuilding schedule for spiny dogfish is the time necessary to rebuild the female portion of the spawning stock biomass if an F of 0.03 is maintained throughout the rebuilding period. To estimate the rebuilding time associated with maintaining a fishing mortality rate of 0.03, a risk analysis of the proposed management scenarios was conducted (see *Appendix A1*; Rago and Sosebee 2002). Based on 1999-2001 survey data, there is a 50% probability that the spiny dogfish population will rebuild to the female SSB_{max} (167,000 mt) by 2016 if the constant fishing mortality rate of 0.03 is maintained over this period in both federal and state waters.

Implementation Schedule *(2.8)*
The Interstate Fishery Management Plan for Spiny Dogfish was approved and adopted by the Commission on November 21st, 2002. States are required to submit implementation proposals by February 1st, 2003. State proposals will be reviewed for approval during the February 2003 ASMFC meeting week. States are required to implement the provisions of the Interstate Fishery Management for Spiny Dogfish by May 1st, 2003.

3.0 Monitoring Program Specifications

The technical committee and advisory panel will meet to review the stock assessment and all other relevant data sources. An annual report will be presented to the Spiny Dogfish and Coastal Shark Management Board in order to evaluate adjustments to the management program as necessary. In addition to the general content of the report, the stock assessment report will also contain information of age/size structure, recruitment, spawning stock biomass, fishing mortality rates, catch and landings data and fishery independent surveys as available.

Commercial Catch and Effort Data Collection Programs *(3.4.1.1)*
In order to monitor the fishery and for the states to forecast when a closure will be needed, dealers with permits issued pursuant to state regulations must submit weekly reports showing, at least, the quantity of spiny dogfish purchased (in pounds), the name and permit number of the individuals from whom the spiny dogfish was purchased. Dealers with state permits must report to the state or NMFS all spiny dogfish purchased. States are required to report state landings weekly to NMFS.

Biological Information *(3.4.3)*
Prior to the implementation of the Interstate FMP for Spiny Dogfish, some states were collecting biological information for spiny dogfish from the commercial fisheries (see *Appendix A.4*). These states should maintain their current monitoring programs and the collection of biological information for spiny dogfish. The collection of biological data should follow the ACCSP guidelines. States without such a program are encouraged to implement a commercial fisheries monitoring program and collect biological information for spiny dogfish.

States collecting fishery independent biological information should maintain their monitoring programs and collect biological information for spiny dogfish. States without such a program are encouraged to implement a fishery independent monitoring program for the collection of biological information for spiny dogfish.

4.0 Management Program Implementation

Currently, the Northwest Atlantic spiny dogfish stock is overfished and overfishing is occurring. The goal of this management plan is to reduce fishing mortality and rebuild the spawning stock biomass to prevent recruitment failure and support a more sustainable fishery. To achieve this goal, the management strategy conserves the mature female portion of the spiny dogfish population to increase recruitment. Rebuilding this late maturing species is further complicated by a directed fishery that at one time focused its effort on the large mature females.

This plan's constant fishing mortality strategy controls the rate of fishing mortality in the spiny dogfish fishery and allows the female portion of the spawning stock to rebuild. This strategy creates low landings in the initial stages of rebuilding. Over time, the total allowable landings (TAL) should increase at a rate that corresponds to the size of the spawning stock. Until the female spawning stock rebuilds to the target SSB, the fishing mortality rate will be held constant at 0.03.

An annual quota will be allocated to the commercial fishery to control fishing mortality. The quota will be based on the projected stock size estimates for that year as derived from the latest stock assessment information. An estimate of stock size coupled with the target fishing mortality rate allows for a calculation of the TAL. The annual commercial quota will be set between zero and the maximum allowed by a fishing mortality rate of 0.03.

Commercial Fisheries Management Measures *(4.1)*
Fishing Year *(4.1.1)*
The spiny dogfish commercial fishery shall operate on a May 1st – April 30th fishing year. The annual coastwide quota will be specified for each fishing year and will begin on May 1st.

Semi-Annual Quota Allocation *(4.1.2)*
The coastwide quota, as determined by the annual specification process described in *Section 4.1.2.1*, shall be distributed between semi-annual periods. In effort to coordinate spiny dogfish management in state waters with the regulations for federal waters, the semi-annual periods are May 1st – October 31st and November 1st – April 30th. A percentage of the coastwide annual quota is allocated to each period and will reflect the level of historical commercial landings during the 1990-1997 reference period. This reference period was chosen to complement the allocation of the quota in federal waters and to facilitate the administration of a coastwide quota. The percentages shall be fixed for both periods, with 57.9% of the coastwide annual quota allocated to Period I and 42.1% to Period II. For a detailed description of the semi-annual quota allocation refer to *Appendix A.2*.

The coastal states shall work with the NMFS to administer the quotas, coordinate coastwide closures, and enforce state and federal regulations. All commercial landings shall count toward the coastwide quota regardless of where the spiny dogfish were harvested. When the quota in any given period is projected to be harvested, the commercial landings, harvest and possession of spiny dogfish will be prohibited in state waters for the remainder of the designated period.

Percentage of Coastwide Commercial Quota Allocated Between the Semi-Annual Periods Based on Historical Landings Between 1990-1997.

Fishing Year	Period I	Period II
May 1- April 30	May 1 - October 30	November 1 - April 30
Percentage of Coastwide Quota	57.9%	42.1%

Annual Process for Setting Fishery Specifications *(4.1.2.1)*
The Spiny Dogfish Technical 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 (when available) or length-based stock projection models, and target mortality levels. Based on this review, the Technical Committee will recommend to the Spiny Dogfish Management Board commercial and recreational measures designed to assure that the target mortality level for spiny dogfish is not exceeded. Specifically, the Technical Committee must recommend possession limits for both semi-annual periods and an annual quota within the range of zero and the maximum allowed by a constant fishing mortality rate of 0.03. The Spiny Dogfish Technical Committee's recommendations will be forwarded to the Spiny Dogfish and Coastal Shark Management Board for final approval. When possible, the Spiny Dogfish Technical Committee will coordinate the annual review of the best available data and recommendations for the annual coastwide quota and possession limits for both semi-annual periods with the New England and Mid-Atlantic Fishery Management Councils' Spiny Dogfish Monitoring Committee.

The Spiny Dogfish and Coastal Shark Management Board will annually receive a stock status update report from the Spiny Dogfish Technical Committee that shall include recommendations for an annual commercial quota and possession limits. The Board will consider this information and determine the quota and possession limits for the following year. All specifications shall remain in place until changed by the Spiny Dogfish and Coastal Shark Management Board. All states must implement measures contained in the final decision made by the Board.

In summary, the steps from the Technical Committee to final action by the Spiny Dogfish and Coastal Shark Management Board are:

1. The Technical Committee reviews the most recent stock status data and makes annual commercial quota and possession limit recommendations to the Management Board.

2. The Board considers the recommendations of the Technical Committee in determining the annual coastwide quota and possession limits. The Board makes final decisions on the coastwide quota and possession limits and establishes compliance criteria and dates.

Payback of Quota Overages *(4.1.2.2)*
When the quota in any given period or location is projected to be reached, the commercial landing, harvest and possession of spiny dogfish will be prohibited in state waters for the remainder of the designated period. When the quota allocated to a semi-annual period is exceeded, the amount over the allocation will be deducted from the corresponding period in the subsequent fishing year.

Quota Rollovers *(4.1.2.3)*
No portion of the annual coastwide quota may be rolled over until the stock has rebuilt to the target SSB. The Spiny Dogfish and Coastal Shark Management Board may consider implementing a rollover provision when the spawning stock has rebuild to the target described in *Section 2.6.1*. When the mature female portion of the spawning stock has reached its target, quota rollovers shall be limited to 5% of the annual coastwide quota. By prohibiting rollovers during the rebuilding period, the plan preserves the intent to maintain the constant fishing mortality from year to year.

Quota Monitoring *(4.1.4.2)*
The coastal states shall work with the NMFS to administer quotas, coordinate coastwide closures, and enforce state and federal regulations. All spiny dogfish landed for sale in a state will be applied against the commercial quota regardless of where the spiny dogfish are harvested. Until ACCSP's quota monitoring program is online, the spiny dogfish commercial landings will be monitored through the National Marine Fisheries Service's Dealer Reporting System. In addition to dealer reports, states will report state landings weekly to NMFS. When the quota is projected to be landed, the Commission's Executive Director will notify each state that commercial landing, harvest and possession of spiny dogfish will be prohibited in state waters for the remainder of the designated period.

Possession Limits *(4.1.5)*
Possession limits will be set annually though the fishing year specification process described in *Section 4.1.2.1*. Vessels are prohibited from landing more than the specified amount in any one twenty-four hour period or calendar day.

Biomedical Supply/Scientific Research *(4.1.6)*
States may issue spiny dogfish exempted fishing permits for the purposes of biomedical supply, as described in *Section 1.3.1.3*. Although there is no restriction on the number of spiny dogfish exempted permits issued, each state is restricted to 1,000 spiny dogfish per year. The amount collected under the state-issued exempted fishing permits will be in addition to the annual quota. States must indicate in the initial implementation plan, and subsequently in the annual state compliance report, that the state will issue exempted permits for the biomedical harvest of spiny dogfish. Annual state reports must indicate the actual amount (in numbers of fish and pounds) collected under exempted fishing permits in the previous fishing year, as well as any other pertinent information (i.e. sex, when and how the spiny dogfish were collected). For more information on this spiny dogfish demand, please refer to *Section 1.3.1.3 Biomedical Industry/Scientific Research*.

Prohibition of Finning *(4.1.7)*
Finning is defined as the act of taking a spiny dogfish, removing the fins, and returning the remainder of the spiny dogfish to the sea. Finning spiny dogfish will be prohibited in all state waters. Vessels that land spiny dogfish must land fins in proportion to carcasses, with a maximum 5% fin to carcass ratio, by weight. Fins may be removed at sea, but the corresponding carcass must be retained. All fins and carcasses must be landed at the same time and in the same location.

***De minimis* Fishery Guidelines** *(4.3.3)*
A state may be granted *de minimis* status if a state's commercial landings of spiny dogfish are less than 1% of the coastwide commercial total. If a state can meet this criterion, the state will be exempt from biological monitoring of the commercial spiny dogfish fishery. All states, including those granted *de minimis* status, will continue to report any spiny dogfish commercial or recreational landings within their jurisdiction.

Adaptive Management *(4.4)*
The Spiny Dogfish and Coastal Shark Management Board may vary the requirements specified in this management plan as a part of adaptive management in order to conserve the spiny dogfish resource. Such changes will be instituted to be effective on the first fishing day of the following year, but may be put in place at an alternative time when deemed necessary by the Management Board. These changes should be discussed with the appropriate federal representatives and Councils prior to implementation in order to be complementary to the regulations for the EEZ.

Measures Subject to Change *(4.4.2)*
The following measures are subject to change under adaptive management upon approval by the Spiny Dogfish and Coastal Shark Management Board:

(1) Overfishing definition;
(2) Rebuilding targets and schedules;
(3) Management areas;
(4) Fishing year and/or seasons;
(5) Fishing year specification process;
(6) Annual specifications for total allowable landings;
(7) Possession Limits;

(8) Seasonal allocation;
(9) Seasonal allocation proportions;
(10) Biomedical research set asides;
(11) Biological research set asides;
(12) Measures to monitor, control, or reduce bycatch;
(13) Compliance Efficiency;
(14) Observer requirements;
(15) Reporting requirements;
(16) Research or monitoring requirements;
(17) Size Limits;
(18) Area closures;
(19) Catch controls;
(20) Gear limitations;
(21) Effort controls;
(22) State-by-state allocation of the coastwide quota;
(23) Regional allocation of the quota;
(24) Allocation of or proportions designated to the components of the regional quota scheme;
(25) Transferability of quota;
(26) Recreational fishery regulatory measures;
(27) Recommendations to the Secretaries for complementary actions in federal jurisdictions; and
(28) Any other management measures currently included in the Spiny Dogfish Management Plan.

Recommendations to the Secretaries for Complementary Actions in Federal Jurisdictions *(4.7)*
The Atlantic States Marine Fisheries Commission believes that the spiny dogfish resource covered by this fishery management plan continues to be overfished and in need of conservation. This plan coordinates the management of spiny dogfish across state boundaries. In order to achieve the goals and objectives of this management plan, the management of spiny dogfish in federal waters should complement the Interstate Fishery Management Plan for Spiny Dogfish.

5.0 Compliance

Mandatory Compliance Elements For States *(5.1)*
A state will be determined to be out of compliance with the provisions of this fishery management plan, according to the terms of Section Seven of the ISFMP Charter if:

- its regulatory and management programs to implement *Section 4* have not been approved by the Spiny Dogfish and Coastal Shark Management Board; or
- it fails to meet any schedule required by *Section 5.1.2*, or any addendum prepared under adaptive management (*Section 4.5*); or
- it has failed to implement a change to its program when determined necessary by the Spiny Dogfish and Coastal Shark Management Board; or
- it makes a change to its regulations required under *Section 4* or any addendum prepared under adaptive management (*Section 4.5*), without prior approval of the Spiny Dogfish and Coastal Shark Management Board.

Mandatory Elements of State Programs *(5.1.1)*
To be considered in compliance with this fishery management plan, all state programs must include harvest controls on spiny dogfish fisheries consistent with the requirements of *Sections 4.0, 4.1* and *4.2*; except that a state may propose an alternative management program under *Section 4.6*, which, if approved by the Management Board, may be implemented as an alternative regulatory requirement for compliance.

Regulatory Requirements *(5.1.1.1)*
States shall begin to implement the Interstate Fishery Management Plan for Spiny Dogfish after final approval by the Commission. Each state must submit its required spiny dogfish regulatory program to the Commission through the ASMFC staff for approval by the Spiny Dogfish and Coastal Shark Management Board. During the period from submission and until the Management Board makes a decision on a state's program, a state may not adopt a less protective management program than contained in this management plan or contained in current state law. While implementing the provisions of the Interstate FMP for spiny dogfish and upon notification of a closure in federal

waters due to the spiny dogfish fishery harvesting the total allowable landings, states waters will close to the commercial harvest, landing and possession of spiny dogfish.

The following lists the specific compliance criteria that a state/jurisdiction must implement in order to be in compliance with the Interstate Fishery Management Plan for Spiny Dogfish:

1. **When the quota is projected to be harvested, states are required to close state waters to the commercial landing, harvest and possession of spiny dogfish for the duration of the seasonal period. Notification of the state's action shall be sent to Commission staff.**
2. **States are required to report landings weekly to NMFS.**
3. **Dealer permits issued pursuant to state regulations must submit weekly reports showing at least the quantity of spiny dogfish purchased (in pounds), the name, and permit number of the individuals from whom the spiny dogfish were purchased.**
4. **States are required to implement possession limits as determined through the annual specification process.**
5. **States must indicate in the implementation plan that exempted permits will be issued for the biomedical harvest of spiny dogfish. Each state is allowed up to 1,000 fish per year. This amount will be allowed in addition to the annual quota. Annual state reports must indicate the actual amount collected under exempted fishing permits.**
6. **State regulations will reflect the prohibition of finning as described in *Section 4.1.7.***

Once approved by the Spiny Dogfish and Coastal Shark Management Board, states are required to obtain prior approval from the Board in order to make any changes to their management program for which a compliance requirement is in effect. Other measures must be reported to the Board but may be implemented without prior Board approval. A state can request permission to implement an alternative to any mandatory compliance measure only if that state can show to the Board's satisfaction that its alternative proposal will have the same conservation value as the measure contained in this management plan or any addenda prepared under Adaptive Management (*Section 4.5*). States submitting alternative proposals must demonstrate that the proposed action will not contribute to overfishing of the resource. All changes in state plans must be submitted in writing to the Board and to the Commission either as part of the annual FMP Review process or the Annual Compliance Reports.

Compliance Schedule *(5.1.2)*
States must implement the Spiny Dogfish Management Plan according to the following schedule:

February 1st, 2003: States must submit programs to implement the Spiny Dogfish Management Plan for approval by the Spiny Dogfish and Coastal Shark Management Board.

May 1st, 2003: All states must implement the Spiny Dogfish Management Plan with their approved management programs. States may begin implementing management programs prior to this deadline if approved by the Management Board.

Reports on compliance must be submitted to ASMFC by each jurisdiction annually, no later than **July 1st, beginning in 2004.**

Compliance Report Content *(5.1.3)*
Each state must submit an annual report concerning its spiny dogfish fisheries and management program for the previous fishing year. Reports should follow the standard report for compliance reports (see *Appendix A.5*), as was adopted by the ISFMP Policy Board. The report shall cover:

- the previous fishing year's fishery and management program including activity and results of monitoring, regulations that were in effect and harvest, including estimates of non-harvest losses;
- the planned management program for the current fishing year summarizing regulations that will be in effect and monitoring programs that will be performed, highlighting any changes from the previous year; and
- the number of spiny dogfish exempted fishing permits issued in the previous fishing year, the actual amount (in numbers of fish and pounds) collected under each exempted fishing permit, as well as any other pertinent information (i.e. sex, when and how the spiny dogfish were collected). The report should also indicate the number of exempted fishing permits issued for the current fishing year.

6.0 Management and Research Needs

The Spiny Dogfish Fishery Management Plan contains a list of management and research needs that should be addressed in the future in order to improve the current state of knowledge of spiny dogfish biology, stock assessment, population dynamics, habitat issues, social and economic issues. By no means are these lists of management and research needs all-inclusive. The management and research needs will be reviewed, updated, and reprioritized annually through the ASMFC's FMP Review process.

7.0 Protected Species

The Spiny Dogfish Fishery Management Plan provides an overview of the protected species known to occur throughout the range of spiny dogfish and that have potential interactions with spiny dogfish fisheries.

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The Interstate Fishery Management Plan for Spiny Dogfish was developed under the supervision of the Atlantic States Marine Fisheries Commission's Spiny Dogfish and Coastal Shark Management Board, chaired by John Connell of New Jersey and Fentress Munden of the North Carolina Division of Marine Fisheries. Members of the Plan Development Team (PDT) included Megan E. Gamble (ASMFC, PDT Chair), Bruce Halgren (New Jersey Department of Fish & Wildlife), Brian Kelly (Massachusetts Division of Marine Fisheries), Tina Moore (North Carolina Division of Marine Fisheries), and William Outten (Maryland Department of Natural Resources).

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

1.1 BACKGROUND INFORMATION

1.1.1 Statement of the Problem

On April 3rd, 1998, National Marine Fisheries Service declared spiny dogfish overfished. Initial management actions to regulate the spiny dogfish fishery began in 1998 with the approval of a draft document called, "The Spiny Dogfish Fishery Management Plan" by the Mid-Atlantic Fishery Management Council (MAFMC) and the New England Fishery Management Council (NEFMC). The fishery management plan (FMP) was partially approved by the National Marine Fisheries Service (NMFS) on September 29, 1999, and the final rule implementing the FMP was published on January 10, 2000. The current federal FMP is based on a constant fishing mortality strategy that allows for low bycatch landings in the initial stages with increased landings as the female portion of the stock rebuilds (MAFMC and NEFMC, 1999). The federal FMP specifies a coastwide target fishing mortality rate of F = 0.03. This F target results in an initial quota of 4 million pounds. The annual quota is split on a semi-annual basis of Period I extending from May 1 through October 31, and Period II from November 1 through April 30. To control the level of effort, the management program also uses possession limits of 600 and 300 pounds for Period I and II, respectively.

Federal action was initiated as increased fishing effort was directed on the spiny dogfish stock, which was a result of the declining abundance of more traditional groundfish resources. With no restraint on the harvest of spiny dogfish in the U.S. EEZ, fishing effort increased and most of the effort was directed on the removal of the adult female component of the stocks. Ultimately, this resulted in National Marine Fisheries Service designating spiny dogfish as overfished on April 3rd, 1998. This action mandated the development of the federal management plan.

The semi-annual quota periods were designed to provide each state with an opportunity to land some quantity of spiny dogfish. However, due to the species' annual migratory pattern, the entire annual quota was taken during the first semi-annual period. As a result, the fishermen in states where the stocks are not available to them until the second harvest period were prohibited from landing spiny dogfish before they even had the opportunity to fish.

There was also concern that the industry infrastructure would disappear due to the low allowable catch limits, thereby eliminating any outlet for fishermen to land spiny dogfish caught as a bycatch in other fisheries or the possibility of restoring a directed fishery once the stock recovers. With out the necessary infrastructure to process the landings, the situation could result in increased discards and more waste while fishing.

The federal plan only regulated the practices of permitted fishermen harvesting in the EEZ. In August 2000, the Atlantic States Marine Fisheries Commission's (ASMFC) Spiny Dogfish and Coastal Shark Management Board took emergency action to close state waters to the commercial harvest, landing, and possession of spiny dogfish when federal waters are closed due to the fishery landing its quota. The intent of the Emergency Action was to: 1) prevent the overharvest of spiny dogfish, thereby reducing the risk of stock collapse; 2) prevent the unregulated portion of the spiny dogfish fishery in state waters from undermining the intent of the federal Spiny Dogfish Management Plan; and 3) provide time for ASMFC to develop an interstate spiny dogfish FMP which would provide a framework for managing the fishery in state waters.

The Spiny Dogfish Emergency Action was due to expire and could not be extended beyond January 31st, 2003 due to ASMFC's policies regarding emergency actions. Emergency actions are effective for 180 days from the date of the Board's declaration of an emergency, at which time the Board can extend the emergency action for two additional periods of up to one year each. The extensions can be made

provided the Board has initiated action to prepare a fishery management plan. The ASMFC's Policy Board approved the development of an interstate fishery management plan for spiny dogfish on May 20, 1999. Approval of an interstate management plan for spiny dogfish (approved November 21, 2002) before the expiration of the Emergency Action (expires January 31, 2003) creates a seamless transition while maintaining coordinated management of the resource across state boundaries.

1.1.2 Benefits of Implementation

When fully implemented, this management plan intends to control the fishing mortality rate in the commercial fishery, leading to increased recruitment and a more stable and sustainable population. The interstate management plan complements the current federal plan for spiny dogfish, which will facilitate the coordination of management efforts throughout both federal and state waters. In addition, the management plan creates the opportunity for consistent possession limits throughout the entire management area, which may increase the time it takes to harvest the quota during each semi-annual period and improve equitable access to the resource throughout the range of the species. Finally, the plan discourages quota overages during the two six month periods by deducting the amount over the allocated quota from the respective period in the following fishing year.

1.1.2.1 Social and Economic Benefits

Throughout the time series of the stock assessment, the spiny dogfish resource has been in a depleted state and continues to be vulnerable to collapse if directed fishing on mature females continues as it did in the 1990's. Any regulatory action that effectively reduces fishing mortality to levels consistent with a high probability of recovery will, inevitably, have short-term adverse effects on both the harvesting and processing sectors of the spiny dogfish fishery. Concomitantly, the reduction of fishing mortality to levels consistent with short-term recovery and, later, long-term sustainability will provide long-term economic opportunity in both the harvesting and processing sectors. Sustaining a viable spiny dogfish fishery benefits fishing communities by helping maintain diversity in the industry and providing opportunities to harvest, process, and further develop support industries.

1.1.2.2 Ecological Benefits

The recovery of the Atlantic coast spiny dogfish population will take almost two decades to restore the species to the level of biomass observed during the 1980s. Spiny dogfish are an important predator in the oceanic ecosystem on the East Coast, preying upon Atlantic herring, Atlantic mackerel, *Loligo* and *Illex* squid. Spiny dogfish are a widespread voracious and opportunistic predator, and as a result are likely competitors with nearly every marine predator within the Northwest Atlantic Ocean ecosystem. Predation on spiny dogfish is not very common. Because spiny dogfish bear well developed live young, predation on pups is limited to larger species of predators, such as sharks, skates, bluefin tuna and goosefish. While rebuilding this overfished population, other species that consume similar prey may fulfill the ecological role of spiny dogfish.

1.2 DESCRIPTION OF THE RESOURCE

The following section and subsections are updated from federal spiny dogfish FMP (MAFMC and NEFMC 1999).

Spiny dogfish and *Squalus acanthias* are the accepted common and scientific names for the species (American Fisheries Society 1970). Spiny dogfish are also known as dogfish, horn dog, piked dogfish, and grayfish (Bigelow and Schroeder 1953). Taxonomically, they are classified as members of the Class Chondrichthyes, Order Squaliformes and Family Squalidae.

The spiny dogfish body is a common small shark that inhabits the temperate and sub-arctic latitudes of the North Atlantic and North Pacific Oceans. They can be easily recognized by the presence of two dorsal fins, each preceded by a sharp spine and by their lack of an anal fin (Figure 1). The upper surface

of the spiny dogfish is slate grey or brownish in coloration with numerous white spots which extend the length of the body, while the lower surface of the body varies from white to gray (Bigelow and Schroeder 1953; Castro 1983).

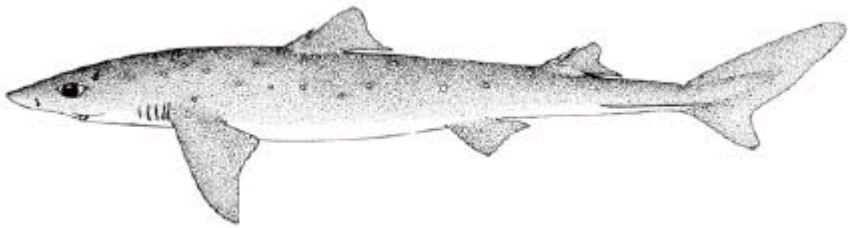

Figure 1. Spiny Dogfish, *Squalus acanthias*.

1.2.1 Species Life History

1.2.1.1 Pupping and Early Life History

Like other members of the family Squalidae, the spiny dogfish is ovoviviparous (no placenta, live bearing). Female dogfish first reach sexual maturity at about 26 in (66 cm; approximate age of 8 years) while males are first sexually mature at 24 in (61 cm; approximate age of 6 years). Nammack *et al.* (1985) reported the length and age at 50% maturity of spiny dogfish in the Northwest Atlantic to be 23.4 in (59.5 cm) and 6 years for males and 30.6 in (77.9 cm) and 12 years for females.

Mating takes place during the winter months in the North Atlantic. Fertilized uterine eggs become encapsulated in a thin, horny transparent shell known as the "candle". Newly fertilized eggs remain encapsulated in the oviduct for 4-6 months and then develop as yolk sac embryos for the ensuing 17-19 months. Prior to fertilization, large ovarian eggs develop over the year concurrently with the second year of development of the previous litter (Nammack *et al.* 1985). The pups are delivered after the two-year gestation period on the offshore wintering grounds. Pups measure 8-12 inches at birth (Castro 1983).

Litter size ranges from 2 to 15 pups (average of 6) with fecundity increasing with length (Soldat 1979). About 40 % of the variability in pup production may be attributable to size of the parent (Nammack *et al.* 1985). Soldat (1979) reported that the mean fecundity of females increased from 6.2 to 6.8 pups per female as average female size increased from 30.7 in (78 cm) to 38.5 in (98 cm). Nammack *et al.* (1985) found a maximum litter size of 15, with an average of 6.5 pups per female for Northwest Atlantic spiny dogfish.

The relationship between stock and recruitment for spiny dogfish, like other elasmobranchs, is direct, owing to their reproductive strategy of low fecundity combined with few, well-developed offspring (Hoenig and Gruber 1990). Although Holden (1977) provides some evidence that the fecundity of sharks can increase as stock size declines, the size of the female body cavity and energy considerations combine to create an upper limit on pup production per adult female. As a result, recruitment to the stock in spiny dogfish is directly related to and dependent upon the number of adult females in the stock. The direct relationship between adult stock and recruitment is the most critical factor in the development of a rational strategy of exploitation of elasmobranch stocks (Hoenig and Gruber 1990), including spiny dogfish.

1.2.1.2 Age and growth

Sexually dimorphic growth in spiny dogfish is strongly apparent. Females attain a greater size than males, reaching maximum lengths up to 49 inches (125 cm) and weights up to 22 lbs (10kg).

Dorsal spine circuli (concentric rings) have been used to estimate age of spiny dogfish in the Northwest Atlantic, as well as in other regions. The spiny dogfish is a long-lived, slow growing species. Nammack *et al.* (1985) reported maximum ages of in the Northwest Atlantic for males and females to be 35 and 40 years, respectively. Hickman *et al*. (2000) reported ages from North Carolina ranging from 12-38 years for females and 3-29 years for males. Holden (1977) reported a maximum age of 25 years for the European population of spiny dogfish. In contrast, McFarlane and Beamish (1987) reported a maximum age of 70 years in the North Pacific. Holden and Meadows (1962) observed ages up to 21 years in the spiny dogfish from the Northeast Atlantic Ocean. Ketchen (1975) reported an age of 64 years and calculated growth parameters of K=0.048 and L_{max} of 125.3 cm for female spiny dogfish in the Northeast Pacific. Nammack *et al.* (1985) reported calculated growth parameters of K=0.106 and L_{max}= 100.5 cm for the Northwest Atlantic population of spiny dogfish.

A study from North Carolina collected and aged 245 dorsal spines, and had only 63% agreement within +1 year between two East Coast readers (Rulifson *et al*. 2002). The West Coast expert, who read the same spines, consistently doubled the ages read by the East Coast readers. Additionally, there was a poor relationship between total length and weight at age. The discrepancies between readers and the poor relationship between length at age casts doubt on any population and harvest models that rely on the age distribution of the spiny dogfish.

1.2.1.3 Length-weight relationship

NEFSC (1994) reported the following length weight relationships for spiny dogfish:

Females: $W = \exp(-15.0251) * L^{3.6069}$ and

Males: $W = \exp(-13.002) * L^{3.097787}$

where W equals weight in kg and L equal length in cm.

1.2.1.4 Distribution

Spiny dogfish are distributed on both sides of the Atlantic Ocean. In the Northwest Atlantic, the species' ranges from Labrador to Florida, but are most abundant from Nova Scotia to Cape Hatteras (Figure 2). They migrate seasonally, moving north in spring and summer and south in fall and winter, but the migratory pattern typically depends on the preferred temperature range, 45º to 55º F. Canadian research surveys indicate that spiny dogfish are distributed throughout the Canadian Maritimes during the summer months. The stock is concentrated in US waters during the fall through spring. Spiny dogfish are considered a unit stock in the Northwest Atlantic Ocean (US and Canadian waters) and, as such, represent an interjurisdictional stock.

1.2.1.5 Food and Feeding

Bowman *et al.* (1984) provided an extensive examination of the spiny dogfish diet, with samples collected from shelf waters of the Northwest Atlantic Ocean during the period 1969-1983. The area studied included continental shelf waters extending from Cape Hatteras, North Carolina to Browns Bank, Nova Scotia. The stomach contents of 10,167 spiny dogfish were examined during this period (about 50% of the stomachs were empty). Fish was the single most important prey item in the diet of spiny dogfish. Herrings (several species), Atlantic mackerel, American sand lance, and codfishes, including species such as Atlantic cod, haddock, silver hake, red hake, white hake and spotted hake were some of most important prey items identified. Other important contributors to the diet of spiny dogfish included *Loligo* and *Illex* squid, ctenophores, crustaceans (principally decapod shrimp and crabs) and bivalves (principally scallop viscera).

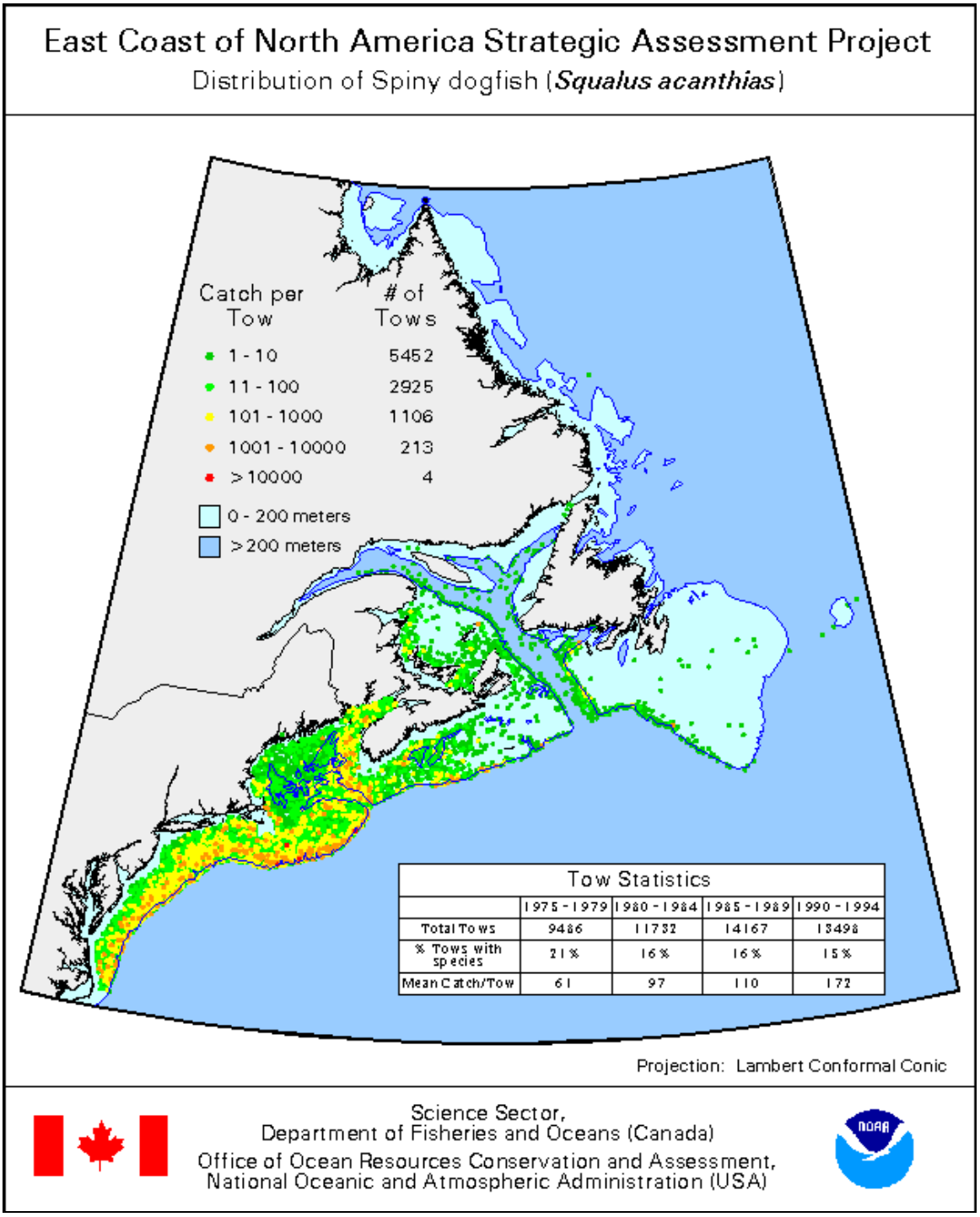

Figure 2. Distribution and abundance of spiny dogfish in the Northwest Atlantic Ocean during 1975-1994.

Source: U.S. NOAA/Canada DFO East Coast of North America Strategic Assessment Project (http://www-orca.nos.noaa.gov/projects/ecnasap/ecnasap_table1.html).

Bowman *et al.* (1984) observed a high degree of variability in the diet of spiny dogfish across seasons, areas and years. This was considered a reflection of their omnivorous nature and the high degree of temporal and spatial variability of both dogfish and their prey. Their diet appears broadly related to abundance trends in some of their major prey items. For example, when herring abundance was declining and mackerel abundance appeared to be at a peak during the period 1969-1972, Bowman *et al.* (1984) found mackerel to predominate in the diet of spiny dogfish. Conversely, during 1973-1976 when mackerel abundance was declining, the incidence of mackerel in the diet of spiny dogfish was substantially reduced.

The incidence of *Loligo* and *Illex* squid in the diet of spiny dogfish is also related to their abundance. Another example of the opportunistic nature of spiny dogfish feeding was the appearance of scallop viscera in their diet after the increase in sea scalloping in the Northwest Atlantic Ocean beginning in 1978. Bowman *et al.* (1984) reported that trends in the incidence of scallop viscera in the diet of spiny dogfish closely followed trends in the level of sea scallop fishing effort in the study area.

1.2.1.7 Predators and competitors

As noted in the previous section, Atlantic herring, Atlantic mackerel, and *Loligo* and *Illex* squid are important components of the diet of spiny dogfish when they are abundant and available. As a result, spiny dogfish are potential competitors with virtually every marine predator within the Northwest Atlantic Ocean ecosystem. Potential competitors include a wide variety of predatory fish, marine mammals and seabirds.

For example, bluefish, sea ravens, and the Atlantic angel shark are known to be major *Loligo* predators. The fourspot flounder, witch flounder, roughtail stingray, and white hake are also known to prey on *Loligo*. In many cases, squid remains in the stomach of fish are only identified as "squid" without reference to species. It is likely that some of these are *Loligo* and there are at least 42 other species of "squid"- eating fish in addition to those identified above (Langton and Bowman 1977). Cetacean and seabird predation upon squid is substantial. Kenney *et al.* (1985) estimated that between 154,000 mt and 224,000 mt of squid were consumed off the northeast US annually by whales and dolphins.

Illex are a major source of food for marine carnivores. Porpoises, whales, and numerous pelagic fishes (e.g., tuna and swordfish) heavily prey upon the larger, adult squid. Other known predators of *Illex* are the fourspot flounder, goosefish, and bluefish. *Illex* is probably eaten by a substantially greater number of fish, however, partially digested animals are often difficult to identify and are simply recorded as squid remains, with no reference to the species. There are at least 47 other species of fish that are known to eat "squid" (Langton and Bowman 1977). As noted above, squid comprise an important component of the diet of marine birds and mammals (Kenney *et al.* 1985).

Atlantic mackerel have been identified in the stomachs of numerous fish species. They are preyed upon heavily by whales, dolphins, silver hake, white hake, weakfish, goosefish, Atlantic cod, bluefish, and striped bass. They also comprise part of the diet of swordfish, red hake, Atlantic bonito, bluefin tuna, blue shark, porbeagle, sea lamprey, and shortfin, mako and thresher sharks (Langton and Bowman 1977).

Spiny dogfish, like other members of the family Squalidae, bear well developed live young ranging in size from 8 to 12 inches in length. Predation upon spiny dogfish, even at a young age, is therefore limited to larger species. Jensen (1965) identified sharks (mackerel, great white, tiger, blue), barndoor skate, lancetfish, bluefin tuna, tilefish and goosefish as predators of spiny dogfish.

1.2.2 Stock Assessment Summary

The status of the spiny dogfish stock in the Northwest Atlantic Ocean was most recently assessed at SAW-26 (NEFSC 1998). The results of that assessment suggest that the spiny dogfish stock in the

Northwest Atlantic began to decline in the early 1990's as a result of the recent increase in exploitation. Swept-area estimates of fishable biomass (defined as dogfish ≥ 31.5 in) increased six-fold from 1969 to 1989 but have since declined to less than 170 million pounds. NMFS research survey data documented a steady rise in both abundance and biomass since the early 1970's. However, because the fishery targets mature females, the estimated biomass of mature females has declined more dramatically (NEFSC 1988). In addition, length frequency data from both US commercial landings and research surveys indicate a pronounced decrease in the average size of females in recent years. For example, in 1997, 75% of the females landed in the NEFSC spring trawl survey were below the length of 50% maturity (NEFSC 1998). In addition, the mean length of female dogfish landed in the commercial fishery declined from 38 inches (97 cm) in 1982 to about 31 inches (78 cm) in 2000.

Since the advent of the recent directed fishery, the estimated levels of fishing mortality have greatly exceeded the replacement level of the stock. The removal of a large portion of the female spawning stock since 1989 has reversed the trend of increasing mature biomass since the late 1970's. The NEFSC spring survey biomass index fluctuated from 86 pounds/tow in 1983 to 330 pounds/tow in 1990. In 2002, the spring survey biomass was 187 pounds/tow. The biomass index for males has fluctuated between 133 pounds/tow in 1990 and 83 pounds/tow in 1997. The male biomass index was 130 pounds/tow in 1996. In 2002, the male biomass index declined to 116 pounds/tow. The female biomass has shown a greater decline during the 1990s, declining from 196 pounds/tow in 1990 to 99 pounds/tow in 1997. Since then, the three year moving average female biomass/tow for the period 2000-2002 was about 142 pounds/tow (Rago 2002).

Minimum biomass estimates based on swept-area estimates from NEFSC spring surveys were segregated by sizes (representing immature and mature female dogfish) in the most recent assessment. The swept-area estimate of the immature female biomass (between 14 and 31 inches or 36 and 79 cm) increased steadily from 37.0 million pounds in 1980 (the first year that dogfish captured by the research survey were recorded by sex) to 452 million pounds in 1997. Large, mature female biomass was over 882 million pounds in 1982, 1988, and 1990. Since 1990, the estimate of mature female biomass declined steadily.

1.2.3 Abundance and Present Condition

A recent update on the status of the spiny dogfish stock was presented at the September 2002 meeting of the Spiny Dogfish Monitoring Committee and was based on the most recent (through spring 2001) audited NEFSC spring trawl survey data and commercial landings data through 2001. The area-swept biomass in the NEFSC spring survey had declined for all sizes since 1992. NEFSC spring survey mean number per tow and biomass per tow values for female spiny dogfish at length for three time periods (1985-1988, 1996-1998, and 1999-2001) were compared. Most notable was the reduction in the biomass of adult females (>80cm) throughout the three year time series. In addition, the large accumulation of female biomass between 60 and 90 cm evident in the 1996-1998 time period has been greatly reduced (based on the 1999-2001 data). The accumulation of female biomass at these medium size classes (which formed a major component of stock biomass in the 1996-1998 period) was the reason for a relatively short rebuilding period (5-10 years) in the federal FMP for spiny dogfish, even though spiny dogfish is a long lived, slow growing elasmobranch.

These data illustrate the effect of the increase in directed fishing on the adult female portion of the stock since 1989 by comparing female numbers and biomass at length during the pre-exploitation phase (1987-1989) and the post-exploitation phase (1999-2001) (Figure 3). Prior to the post-1989 expansion of the directed fishery, the stock was comprised of an accumulation of large adult females (>80 cm) and a substantial number of small dogfish (<40 cm) which were the offspring that resulted from the accumulation of adult females. Since the advent of the directed fishery, the abundance of the adult female portion of the stock has dramatically declined (Figure 4). As a result, pup production has also declined

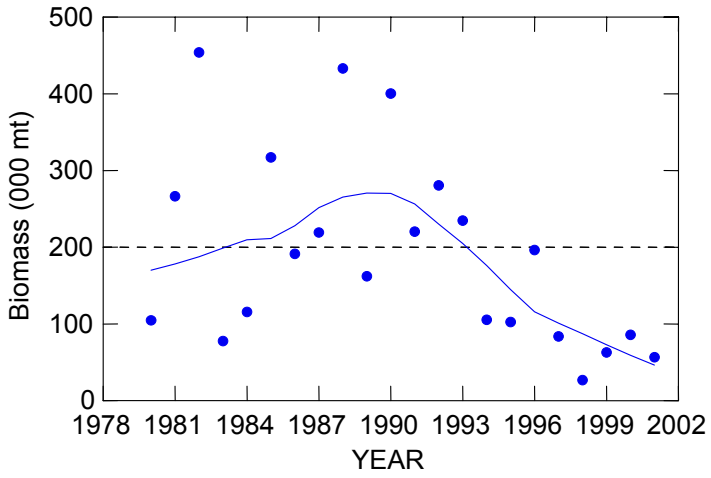

Figure 3. The swept area biomass of females (>=80 cm) from 1978-2001 (Rago and Sosebee 2002).

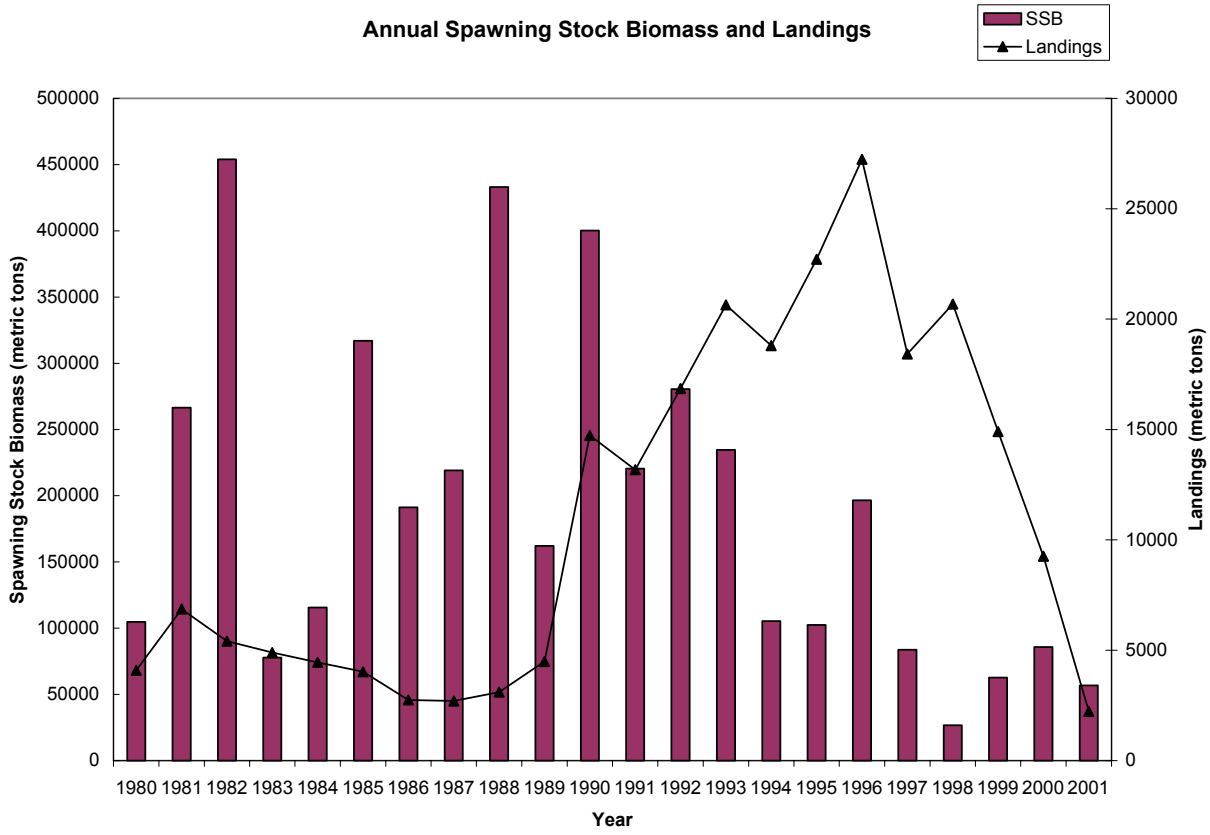

Figure 4. The swept area spawning stock biomass and US Northwest Atlantic spiny dogfish commercial landings (metric tons), 1980-2001.

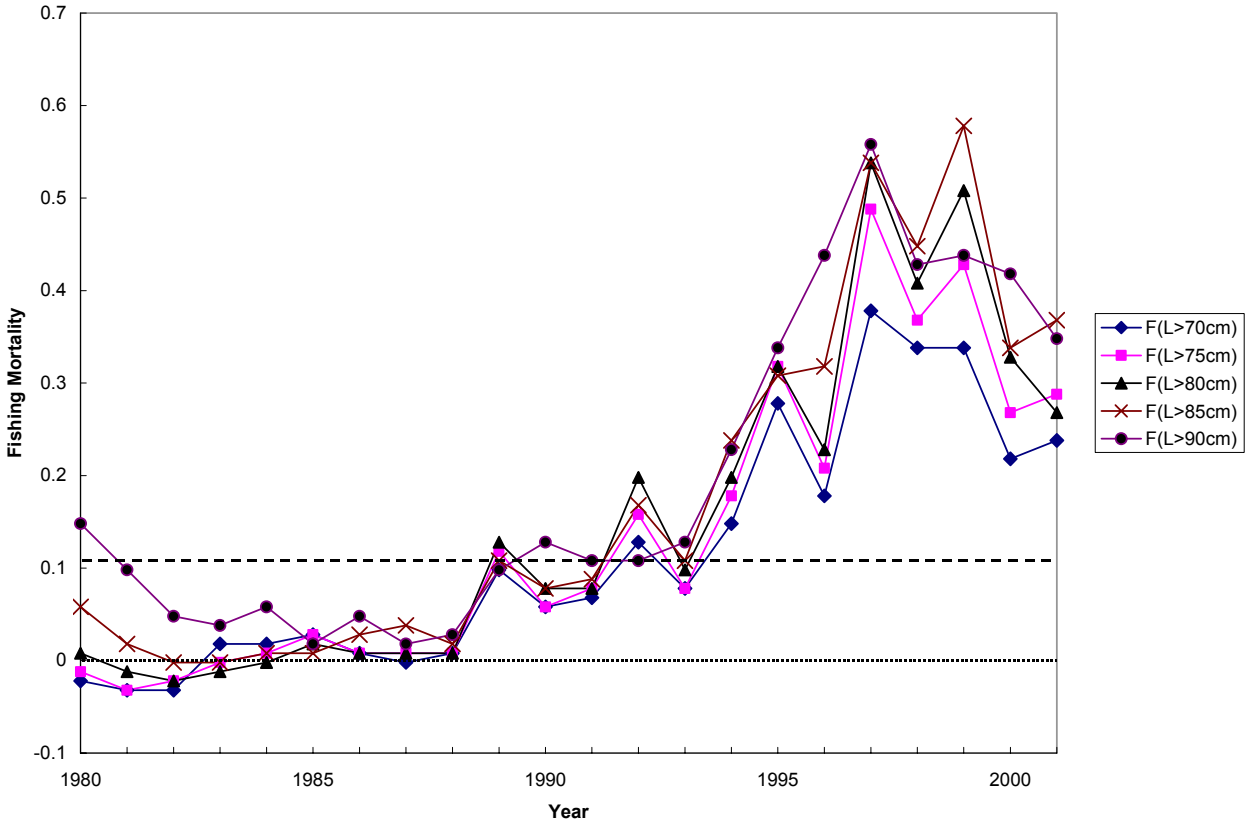

Figure 5. Spiny dogfish fishing mortality rates (assuming M=0.092), 1980 – 2000 (Rago and Sosebee 2002).

dramatically in recent years. The survey indices for pups have been the lowest in the time series for the past six consecutive years (1997-2002), indicating recruitment failure. The recruitment failure can be attributed to the dramatic reduction in the adult female biomass.

In addition, fishing mortality estimates from the Beverton-Holt model have increased dramatically from less than 0.05 prior to 1990 to greater than 0.3 since about 1995 (Rago personal communication). Fishing mortality has exceeded the threshold level of 0.11 since 1991 regardless of the assumed level of natural mortality (0.061 to 0.092) and the size at entry into the fishery (70 to 90 cm) (Figure 5). In the late 1980's and early 1990's, the fishery targeted large females around 95 cm, but over time the average length has decreased below 80 cm. Today, the fishery targets a broader range of lengths (70 cm to 90 cm). With the average size at entry into the fishery decreasing over time and the fishery targeting a broader range of sizes or age groups, fishing mortality has a more significant impact on the spiny dogfish population. Based on the three year-year average of 1999-2001, the most recent estimate of fishing mortality was F=0.27 (Rago personal communication).

Updated NEFSC survey indices (number and weight per tow), swept area biomass estimates, and length frequency distributions of spiny dogfish were also examined by the Spiny Dogfish Monitoring Committee. Survey data illustrated the dramatic reduction in the biomass of spiny dogfish pups based on the decline in biomass of dogfish <35cm. In addition, the most recent 3-yr average (2000-2002) estimate of adult female biomass is about 72,600 mt or 44% of the spawning stock biomass rebuilding target (167,000 mt).

1.3 DESCRIPTION OF THE FISHERY

1.3.1 Commercial Fishery

This section is updated from federal spiny dogfish FMP (MAFMC and NEFMC 1999).

United States fishermen have landed spiny dogfish along the Northeastern coast of the US since the 1880's (Bigelow and Schroeder 1953). The early domestic fishery utilized longlines and otter trawls but was of relatively minor importance to the US fishery due to low market demand. In fact, spiny dogfish were generally avoided by US fishermen and were only slightly exploited during the late 19th and most of the 20th century. However, spiny dogfish have been a popular foodfish in various European markets and have also been the target of the foreign fishing fleets throughout the world, including the east coast of North America (Soldat 1979).

The history of the US commercial fishery for spiny dogfish can be divided into three distinct phases. The first phase, prior to the passage of the Fishery Conservation and Management Act, reported US commercial landings of spiny dogfish were very low. Historical records dating back to 1931 indicate that US commercial landings of spiny dogfish were less than 0.25 million pounds (100 mt) landed per year prior to 1960 (NEFSC 1998). There was a modest increase in dogfish landings from 1962-1966, when US fishermen landed an average of 1.2 million pounds. The annual US domestic spiny dogfish landings from Maine to North Carolina were roughly about 0.7 million pounds (359 mt) from 1962-1978 (Table 1). Following the passage of the Fishery Conservation and Management Act, foreign fishing for spiny dogfish in the EEZ ceased. The second phase, with moderate landings, between 1979-1989. US commercial spiny dogfish landings ranged from 9-15 million pounds (4,000-6,800 mt) with an annual average of 11.7 million pounds (5,300 mt).

Beginning in 1990, the US commercial fishery for spiny dogfish expanded dramatically. Landings increased six-fold from roughly 10 million pounds (4,500 mt) in 1989 to 60 million pounds (27,000 mt) in 1996. Spiny dogfish commercial landings declined to 45.2 million pounds (20,500 mt) in 1997. During this third phase of rapid fishery expansion (1990-1997), US commercial landings averaged about 40 million pounds (18,000 mt). Cumulative removals during this eight-year period were roughly 340 million pounds (154,000 mt). In contrast, cumulative US landings for the period 1962-1989 (i.e., the previous 28 years) were only 118.6 million pounds (54,000 mt). Combined foreign landings from 1965-1977 were about 345 million pounds (156,000 mt). Thus, since 1990, the recently expanded US fishery has landed approximately the same weight of spiny dogfish in 8 years that the foreign fishery removed in the 13 years prior to the passage of the Fishery Conservation and Management Act. However, although the reported weight of landings was similar, the recent US fishery generated significant discards and the landings were comprised almost exclusively of mature females. In contrast, the foreign fishery prosecuted all sizes of spiny dogfish with minimal discarding (NEFSC 1998).

Spiny dogfish are landed in every state from Maine to North Carolina (Table 2). However, prior to 1990, Massachusetts was responsible for the majority of commercial spiny dogfish landings. Beginning in 1989 (as the US fishery expansion started), the states of New Jersey, Maryland and Maine began to increase in importance. By 1996, the expansion of the spiny dogfish fishery had occurred in virtually every state, especially in North Carolina (1992-2000). Overall, Massachusetts and North Carolina recorded the highest landings of spiny dogfish during the period 1988-2001, followed by New Jersey, Maryland, Maine, Virginia, Rhode Island, and New Hampshire (Table 3). More recently (i.e. during the period 1994-2000), Massachusetts, North Carolina, New Jersey, Maryland, and Virginia have accounted for the majority of the spiny dogfish landings (Table 2).

Spiny dogfish are landed in all months of the year (Table 4) and throughout a broad area with the distribution of landings varying by area and season. During the fall and winter months, spiny dogfish are captured principally in Mid-Atlantic waters and southward from New Jersey to North Carolina. During

the spring and summer months, spiny dogfish are landed mainly in northern waters from New York to Maine (Table 4).

Based on NMFS weighout data, numerous gear types reportedly took spiny dogfish (Table 5). However, two principal gear types (trawls and gill nets), historically, accounted for the majority of the spiny dogfish commercial landings (Tables 5 and 6). From 1988-1990, trawls and gill nets landed roughly equal amounts of spiny dogfish. As the fishery expanded in the early 1990's, the importance of gill nets

Table 1. Spiny Dogfish Landings (pounds) for the Northwest Atlantic Ocean.

YEAR	CANADA	US COMM	US REC*	US TOTAL	USSR	OTHER	TOTAL (STOCK)
1962	0	518,081	n/a	518,081	0	0	518,081
1963	0	1,344,806	n/a	1,344,806	0	2,205	1,347,011
1964	0	1,609,358	n/a	1,609,358	0	35,274	1,644,632
1965	19,841	1,075,845	n/a	1,075,845	41,465	22,046	1,159,197
1966	85,979	1,274,259	n/a	1,274,259	20,698,989	0	22,059,227
1967	0	612,879	n/a	612,879	5,370,406	0	5,983,285
1968	0	38,327	n/a	38,327	9,709,058	0	9,747,385
1969	0	249,120	n/a	249,120	19,460,004	800,270	20,509,394
1970	41,887	233,688	n/a	233,688	10,855,450	1,578,494	12,709,519
1971	8,818	160,936	n/a	160,936	23,814,089	1,684,314	25,668,157
1972	6,614	152,117	n/a	152,117	51,371,589	1,518,969	53,049,289
1973	44,092	196,209	n/a	196,209	31,347,207	10,083,840	41,671,348
1974	79,366	279,984	n/a	279,984	45,070,842	8,970,517	54,400,709
1975	2,205	324,076	n/a	324,076	49,230,923	423,283	49,980,487
1976	6,614	1,212,530	n/a	1,212,530	36,774,933	235,892	38,229,969
1977	2,205	2,052,483	n/a	2,052,483	15,304,333	566,582	17,925,603
1978	185,186	1,825,409	n/a	1,825,409	1,272,054	99,207	3,381,856
1979	2,934,323	10,597,512	n/a	10,597,512	231,483	180,777	13,944,095
1980	1,477,082	9,027,837	n/a	9,027,837	773,815	546,741	11,825,475
1981	1,243,394	15,282,287	3,284,837	18,567,124	1,137,574	1,009,707	21,957,799
1982	2,100,984	11,929,091	154,946	12,084,037	59,524	742,950	14,987,495
1983	0	10,795,926	147,565	10,943,491	791,451	231,483	11,966,425
1984	8,818	9,810,470	200,888	10,011,358	641,539	220,460	10,882,175
1985	28,660	8,880,129	196,174	9,076,303	1,529,992	701,063	11,336,018
1986	46,297	6,058,241	403,073	6,461,314	471,784	339,508	7,318,903
1987	617,288	5,959,034	673,514	6,632,548	255,734	50,706	7,556,276
1988	0	6,734,774	792,385	7,527,159	1,265,440	160,936	8,953,535
1989	370,440	9,903,020	921,481	10,824,501	372,577	191,800	11,759,318
1990	2,901,780	32,474,444	392,750	32,867,194	844,362	22,046	36,635,382
1991	674,730	29,049,112	287,892	29,337,004	480,603	35,274	30,527,611
1992	1,913,940	37,164,817	534,798	37,699,615	57,320	90,389	39,761,264
1993	3,168,585	46,771,518	263,373	47,034,891	0	0	50,203,476
1994	4,013,100	41,440,740	340,692	41,781,432	0	0	45,794,532
1995	2,110,185	47,592,585	148,665	47,741,250	0	0	49,851,435
1996	952,560	59,359,721	56,887	59,416,608	0	0	60,369,168
1997	983,430	45,034,113	146,295	45,180,408	0	0	46,163,838
1998	2,383,605	47,428,917	133,518	47,562,435	0	0	49,946,040
1999	5,441,940	33,862,195	119,378	33,981,573	0	0	39,423,513
2000	5,865,300	21,104,504	22,242	21,126,746	0	0	26,992,046
2001	8,279,775	5,067,090	61,765	5,128,855	0	0	13,408,630

* Recreational landings come from MRFSS, catch (type A + B1) in numbers of fish multiplied by 5.5 lbs (an average weight from SAW-26).

Source: Unpublished NMFS Weighout Data, NMFS South Atlantic General Canvas Data, SAW-26, and Canadian Department of Fisheries and Oceans.

Table 2. US East Coast Commercial Spiny Dogfish Landings (pounds) by State, 1988-2001.

	STATE											
YEAR	ME	NH	MA	RI	CT	NY	NJ	DE	MD	VA	NC	Grand Total
1988	481,481	507	5,827,932	573	.	86,243	10,141	.	23,523	3,373	301,768	6,735,542
1989	4,879,563	.	4,924,581	4,475	904	48,280	22,575	.	3,549	19,092	.	9,903,020
1990	6,365,961	185,185	17,806,526	1,300,860	24,295	18,166	4,544,004	.	2,181,812	6,636	41,446	32,474,890
1991	2,016,160	.	14,488,889	3,160,229	8,796	77,271	2,715,631	5,710	4,939,242	173,964	1,463,221	29,049,112
1992	1,719,400	402,183	18,375,750	2,027,601	22,310	155,666	2,534,590	.	3,063,294	229,101	8,634,923	37,164,817
1993	3,524,780	1,641,601	26,830,776	1,924,272	14,947	95,392	769,996	.	1,795,899	1,367,791	8,806,064	46,771,518
1994	1,813,347	2,597,792	23,209,664	529,255	170,000	237,087	1,129,854	.	1,428,630	447,450	8,873,801	40,436,880
1995	1,663,568	2,106,255	28,636,503	572,914	293,532	933,723	2,379,972	62,900	3,117,403	651,012	7,174,803	47,592,585
1996	911,048	1,079,523	26,812,018	1,128,583	705,865	1,245,749	4,632,137	.	7,151,026	2,483,038	13,210,735	59,359,721
1997	448,660	1,008,785	21,664,398	1,015,395	347,381	488,724	3,950,032	.	4,227,432	4,274,881	7,608,426	45,034,113
1998	273,752	1,893,425	24,911,195	1,769,038	267,287	1,456,519	6,305,288	1,905	2,398,994	3,190,135	4,961,379	47,428,917
1999	34,811	1,238,493	14,915,041	1,337,600	87,924	1,452,710	3,924,618	414	2,134,023	5,017,933	3,718,628	33,862,195
2000*	7,661	2,334,498	5,761,654	305,702	30,131	1,901,906	5,222,164	235	449,696	1,544,689	3,549,939	21,108,274
2001*	257	382,502	3,912,481	394,019	7,677	66,652	17,149	13	116	126,242	373	4,907,481

* Landings were constrained by the implementation of the Federal Spiny Dogfish FMP and the ASMFC Emergency Action.

Source: Unpublished NMFS Weighout Data and North Carolina Trip Ticket Program.

Table 3. Spiny Dogfish Average Annual Commercial Landings (pounds) by State, 1988-2001.

State	Landings	Percent
Maine	1,724,318	5.23%
New Hampshire	1,062,196	3.22%
Massachusetts	17,005,529	51.55%
Rhode Island	1,105,037	3.35%
Connecticut	141,503	0.43%
New York	590,292	1.79%
New Jersey	2,725,582	8.26%
Delaware	5,084	0.02%
Maryland	2,351,046	7.13%
Virginia	1,395,381	4.23%
North Carolina	4,881,822	14.80%
All States	32,987,790	100.00%

Source: Unpublished NMFS Weighout Data and North Carolina Trip Ticket Program.

Table 4. Spiny Dogfish Commercial Landings (pounds) by State and Month, 1988-2001 combined.

		MONTH												
	Not Categorized	January	February	March	April	May	June	July	August	September	October	November	December	Total
ME		21,590	24,584	15,188	350,136	838,618	5,445,126	7,528,660	5,728,576	3,077,726	990,077	105,132	15,035	24,140,450
NH		67,875	45,675	32,535	94,472	217,615	2,579,620	4,019,871	3,832,048	1,583,181	1,415,478	743,313	239,064	14,870,748
MA	1,825,022	1,195,943	261,884	376,954	3,753,499	15,152,892	35,452,331	53,432,273	46,278,321	34,198,698	28,092,914	13,658,295	4,398,382	238,077,407
RI		2,704,701	315,419	297,014	983,026	857,747	1,781,360	570,593	738,884	889,145	1,820,562	2,106,954	2,405,111	15,470,517
CT	242,052	156,283	70,093	86,070	166,895	95,212	250,989	114,252	39,118	126,700	287,257	254,218	91,910	1,981,049
NY	45,150	840,165	761,245	1,068,031	354,881	378,877	488,154	232,288	177,743	165,478	577,406	1,461,488	1,713,183	8,264,089
NJ		4,695,883	4,534,026	4,136,758	3,948,857	900,369	178,107	59,464	108,648	210,268	3,234,820	8,984,791	7,166,159	38,158,149
DE	62,900				64	81	540	1,196	450	212		2	5,732	71,177
MD		8,385,502	5,072,837	7,544,416	3,882,087	53,888	216,271	41,552	353	639	2,734	2,471,356	5,243,003	32,914,639
VA	1,146	7,168,861	3,949,461	2,706,250	1,595,931	454,028	56,739	11,662	8,155	3,384	12,439	787,166	2,780,113	19,535,336
NC		15,757,362	22,982,972	18,647,187	2,295,022	21,738	12,083	2,950	3,889	4,635	14,654	507,856	8,095,160	68,345,508
Total	2,176,271	40,994,165	38,018,196	34,910,404	17,424,871	18,971,065	46,461,321	66,014,760	56,916,185	40,260,066	36,448,341	31,080,571	32,152,852	461,829,069

Source: Unpublished NMFS Weighout Data and North Carolina Trip Ticket Program.

Table 5. Spiny Dogfish Commercial Landings (pounds) by Gear, Maine to Florida, 1988-2001combined.

Gear	Landings (lbs)	Percent
Beam Trawl	38,109	0.01%
Fish Otter Trawl	95,815,020	20.95%
Other Otter Trawl	233,885	0.05%
Pair Trawl	904	0.00%
Scallop Otter Trawl	8,662	0.00%
Shrimp Trawl	2,586	0.00%
Drift Gill Net	10,376,423	2.27%
Set Gill Net	9,895	0.00%
Sink Gill Net	323,837,403	70.82%
Stake Gill Net	19,466	0.00%
Runaround Gill Net	47,751	0.01%
Other Gill Net	24,274	0.01%
Longline, bottom	23,113,275	5.05%
Longline, Pelagic	914,190	0.20%
Hand Line	376,177	0.08%
Troll/Handline	26,070	0.01%
Danish Seine	20	0.00%
Haul Seine	472,129	0.10%
Menhaden Purse Seine	85	0.00%
Scottish Seine Net	248,968	0.05%
Stop Seine	4,200	0.00%
Fyke Net	426	0.00%
Fish Pound Net	119,040	0.03%
Pound Net	4,530	0.00%
Trammel Net	4,078	0.00%
Crab Pot/Trap	10,187	0.00%
Lobster Pot Inshore	5,088	0.00%
Lobster Pot Offshore	909	0.00%
Fish Pot/Trap	10,785	0.00%
Floating Trap	9,774	0.00%
Other Pots & Traps	140	0.00%
Sea Scallop Dredge	4,597	0.00%
Surf Clam/Quahog Dredge	1,158	0.00%
Other	1,513,810	0.33%
Total	**457,254,014**	**100.00%**

Source: Unpublished NMFS Weighout Data.

increased dramatically (Table 6). In 1991, gill nets accounted for greater than 60% of the dogfish landed and increased to almost 75% of the landings by 1993. In 1996, gill nets accounted for greater than 80% of the 60 million pounds of spiny dogfish landed in that year. Thus, the recent increase in spiny dogfish landings is largely due to an increase in gill net activity within the fishery. In addition, there has been a surge in dogfish landings taken by longline (Table 6). In 2001, the longline gear accounted for over 57% of the landings for the Atlantic coast. The landings of spiny dogfish by gear type by state, for the period 1988-2001, are given in Table 7.

A total of 21.1 million pounds of spiny dogfish was landed during the calendar year 2000 based on NMFS dealer reports (Table 1). This annual total does not include dogfish reported as unclassified (not specified as either spiny or smooth dogfish). The federal spiny dogfish regulations were implemented on April 3, 2000. The quota specified for the fishing year that began May 1, 2000 (fishing year 2000), was allocated to two quota periods (May – October, November – April 2001). The commercial quota allocated to the first semi-annual period (2,316,000 pounds) was landed quickly and the fishery for federally permitted vessels was closed on August 1, 2000. Despite the federal closure, landings continued to be landed legally by vessels fishing exclusively within state waters. Prior to the start of the second semi-annual period, it was determined that landings from the first period exceeded the quota allocated to the second

Table 6. Spiny Dogfish Commercial Landings by Year and Gear Type, Maine to Florida combined.

	YEAR													
GEAR	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Beam Trawl	.	.	.	0.13%	.	.	.	0.00%	.	.	.	.	.	.
Fish Otter Trawl	51.19%	10.82%	47.59%	39.53%	28.39%	24.04%	16.26%	12.46%	12.40%	9.80%	12.92%	14.71%	33.97%	11.36%
Other Otter Trawl	.	.	.	.	0.00%	.	.	0.00%	0.12%	0.01%	0.21%	0.18%	.	.
Pair Trawl	.	.	.	0.00%	0.00%	.	0.00%	.	.	.	.	.	.	.
Scallop Otter Trawl	.	.	.	.	.	0.00%	0.00%	0.02%	.	.	.	.	.	0.00%
Shrimp Trawl	0.00%	0.01%	.	.	.	.	.	.	.	.	.	.	0.01%	.
Drift Gill Net	0.40%	0.17%	0.10%	0.82%	1.02%	0.36%	0.14%	1.51%	4.66%	5.59%	6.38%	2.19%	0.17%	0.03%
Set Gill Net	.	.	.	.	.	.	0.02%	0.00%	.	.	.	0.00%	0.00%	.
Sink Gill Net	47.97%	85.46%	52.17%	59.24%	69.05%	74.31%	80.30%	78.19%	77.62%	78.23%	73.03%	70.40%	46.43%	30.52%
Stake Gill Net	.	.	.	.	.	.	.	.	0.00%	0.00%	0.03%	0.01%	0.00%	.
Runaround Gill Net	0.20%	0.29%	0.00%	0.00%	.	0.01%	.	.	.	.	.	.	.	.
Other Gill Net	.	0.00%	0.00%	0.00%	0.00%	0.02%	.	0.03%	.	.	.	.	.	.
Longline, bottom	0.15%	3.07%	0.07%	0.19%	0.06%	1.18%	2.57%	6.40%	4.75%	5.78%	6.20%	9.68%	19.19%	57.34%
Longline, Pelagic	.	0.01%	0.04%	0.05%	.	0.00%	.	0.22%	0.09%	0.13%	0.63%	1.16%	0.00%	0.00%
Hand Line	0.00%	0.14%	0.01%	0.00%	0.11%	0.04%	0.02%	0.05%	0.03%	0.10%	0.35%	0.07%	0.08%	0.24%
Troll/Handline	.	.	.	.	.	.	.	.	.	0.05%	0.00%	0.00%	0.02%	.
Danish Seine	.	.	.	.	.	.	.	0.00%	.	.	.	.	.	.
Haul Seine	0.06%	0.01%	0.00%	0.03%	1.20%	0.01%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
M. Purse Seine	.	.	.	.	.	.	.	0.00%	.	.	.	.	.	.
Scottish Seine Net	.	.	.	.	.	0.00%	0.02%	0.01%	0.04%	0.07%	0.21%	0.24%	0.01%	0.04%
Stop Seine	.	.	.	.	.	.	.	.	.	0.01%	.	.	.	.
Fyke Net	.	.	.	.	.	.	.	.	0.00%	.	.	0.00%	.	.
Fish Pound Net	0.03%	0.01%	0.01%	0.01%	0.02%	0.00%	0.01%	0.02%	0.03%	0.04%	0.02%	0.08%	0.08%	0.06%
Pound Net	.	.	.	.	.	0.01%	0.00%	0.00%	.	.	.	.	.	.
Trammel Net	.	.	.	.	.	0.01%	.	.	.	.	.	.	.	.
Crab Pot/Trap	.	.	.	.	.	.	.	.	.	.	.	0.03%	.	.
Lobster Pot Inshore	.	.	.	.	.	0.00%	.	0.00%	.	.	0.00%	0.00%	0.01%	.
Lobster Pot Offshore	.	.	.	.	.	.	0.00%	0.00%	0.00%	.	0.00%	0.00%	.	.
Fish Pot/Trap	.	0.00%	0.00%	0.00%	.	.	0.00%	.	0.00%	0.00%	0.00%	0.03%	0.01%	0.00%
Floating Trap	.	.	0.00%	.	0.00%	0.00%	0.00%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%
Other Pots & Traps	.	.	.	.	.	.	.	.	.	.	0.00%	.	.	.
Sea Scallop Dredge	.	.	.	.	0.01%	.	.	.	0.00%	.	.	.	.	.
Surf Clam Dredge	.	.	.	.	.	.	.	.	0.00%	0.00%	.	.	.	.
Other	.	.	.	.	0.15%	0.00%	0.67%	1.08%	0.26%	0.16%	0.01%	1.21%	0.01%	0.40%
Grand Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: Unpublished NMFS Weighout Data.

Table 7. Spiny Dogfish Commercial Landings By State and Gear Type, 1988-2001 combined.

GEAR	ME	NH	MA	RI	CT	NY	NJ	DE	MD	VA	NC
Beam Trawl	.	.	.	.	.	.	0.10%	.	.	.	.
Fish Otter Trawl	1.52%	6.04%	19.53%	23.19%	67.22%	90.05%	50.34%	.	32.72%	15.38%	4.14%
Other Otter Trawl	.	.	.	.	.	.	.	.	0.22%	.	0.25%
Pair Trawl	.	.	.	0.00%	.	0.01%	.	.	.	.	.
Scallop Otter Trawl	.	.	.	.	.	.	0.02%	.	.	0.00%	.
Shrimp Trawl	0.00%	0.00%	0.00%	.	.	.	.	.	.	.	0.00%
Drift Gill Net	.	.	0.00%	0.00%	.	0.15%	23.86%	75.39%	1.77%	2.87%	0.10%
Set Gill Net	.	.	0.00%	.	.	0.00%	.	.	.	.	0.00%
Sink Gill Net	96.41%	93.53%	70.56%	76.38%	6.59%	6.47%	22.32%	.	65.05%	79.52%	95.37%
Stake Gill Net	.	.	.	.	0.05%	.	.	0.12%	.	0.09%	.
Runaround Gill Net	.	.	0.02%	.	.	.	0.03%	.	.	.	.
Other Gill Net	.	.	.	.	0.42%	.	.	21.78%	.	.	.
Longline, bottom	2.01%	0.25%	9.27%	0.01%	0.71%	1.38%	1.02%	.	.	.	.
Longline, Pelagic	0.00%	.	0.00%	.	2.23%	0.27%	2.05%	.	0.18%	.	0.00%
Hand Line	0.06%	0.14%	0.12%	0.00%	0.01%	0.30%	0.00%	2.62%	0.00%	0.03%	0.02%
Troll/Handline	.	.	.	.	.	.	.	.	.	.	0.04%
Danish Seine	.	.	0.00%	.	.	.	.	.	.	.	.
Haul Seine	.	.	0.19%	.	.	0.00%	.	.	.	0.08%	0.01%
Menhaden Purse Seine	.	.	.	.	.	.	0.00%	.	.	.	.
Scottish Seine Net	.	.	0.10%	.	.	.	.	.	.	.	.
Stop Seine	.	.	.	.	.	.	.	.	.	.	0.01%
Fyke Net	.	.	.	.	.	0.01%	.	0.00%	.	.	.
Fish Pound Net	.	.	.	.	0.06%	1.31%	0.02%	.	0.00%	0.01%	0.00%
Pound Net	.	.	.	.	.	0.05%	.	.	.	.	.
Trammel Net	.	.	.	.	.	.	0.01%	.	.	.	.
Crab Pot/Trap	.	.	0.00%	.	.	.	.	.	.	.	0.02%
Lobster Pot Inshore	.	0.00%	0.00%	0.02%	.	.	0.00%	.	.	.	.
Lobster Pot Offshore	.	0.01%	.	.	0.00%	.	0.00%	.	.	.	.
Fish Pot/Trap	.	.	0.00%	0.01%	.	0.00%	0.00%	.	0.03%	.	0.00%
Floating Trap	.	.	.	0.06%	.	.	.	.	.	.	.
Other Pots & Traps	.	.	0.00%	.	.	.	.	.	.	.	.
Sea Scallop Dredge	.	.	0.00%	0.00%	.	.	0.00%	.	.	.	.
Surf Clam/Quahog Dredge	.	.	.	.	.	.	0.00%	.	.	.	.
Other	.	0.03%	0.20%	0.33%	22.71%	.	0.22%	0.10%	0.03%	2.02%	0.04%
Grand Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Source: Unpublished NMFS Weighout Data.

period (November 2000 – April 2001). As a result, the federal closure of the spiny dogfish fishery remained in effect for the entire second quota period, and ASMFC enacted the Spiny Dogfish Emergency Action to close the fishery in state waters also. Because regulations in both state and federal waters were not in place at the start of the 2000 fishing year, spiny dogfish were landed in all months in 2000 with peak landings occurring during the months of January – March and June – August. In calendar year 2000, Massachusetts accounted for the largest share of the landings (27.3%), New Jersey (24.7%), North Carolina (16.8%), and New Hampshire (11.1%).

1.3.1.1 Massachusetts Commercial Spiny Dogfish Fishery

The directed spiny dogfish fishery began in Massachusetts in the mid-1980s. During the 1980's through the 1990's, sink gill netters and trawlers fishing in state waters and adjacent waters of the EEZ dominated landings. During the mid-1990's, DMF successfully petitioned NMFS to allow a directed trawl fishery for spiny dogfish with small-mesh on Nantucket Shoals. Massachusetts' annual landings exceeded 20 million lbs per year from 1993 through 1998 (Table 8).

Table 8. Massachusetts Spiny Dogfish Commercial Landings (pounds) by Gear, 1988-2001.

Year	Longline	Gill Net	Trawl	Hand Line	Other	Total
1988	0	2,810,604	3,017,328	0	0	5,827,932
1989	1,058	3,988,713	934,722	0	66	4,924,559
1990	0	9,375,176	8,431,305	0	0	17,806,481
1991	22	10,556,944	3,931,944	0	0	14,488,911
1992	17,416	12,387,743	5,428,175	39,991	502,381	18,375,705
1993	516,446	16,742,350	9,564,043	5,004	2,954	26,830,798
1994	1,028,170	17,643,337	4,437,837	3,850	96,470	23,209,664
1995	3,053,063	22,388,953	3,001,454	20,495	172,538	28,636,503
1996	2,814,501	21,631,547	2,186,288	10,897	168,785	26,812,018
1997	2,331,409	17,617,082	1,647,354	31,327	37,242	21,664,415
1998	2,418,850	19,575,163	2,677,111	143,065	97,006	24,911,195
1999	3,168,747	10,600,886	1,048,361	17,899	79,148	14,915,041
2000	3,913,515	1,709,692	122,650	13,267	2,530	5,761,654
2001	2,813,573	995,693	79,388	9,827	14,000	3,912,481
Total	22,076,771	168,023,883	46,507,961	295,623	1,173,120	238,077,357

Source: Unpublished NMFS Weighout Data.

The Massachusetts spiny dogfish fishery became substantially smaller in scale with the implementation of the federal management plan in 2000 and was accompanied by a significant change in the pattern of dogfish landings by gear type. The dominant gear types of the 1980's and 1990's have been constrained by the federal regulations. Since the implementation of the plan, only the longline fishery and a reduced gill net fishery remain as viable fisheries on a seasonal basis. In 1993, longlining landings first achieved significance in Massachusetts. Only longlining has maintained a consistent (1995-2001) level of landings between 2.5-4 million pounds per year (Table 8). The proportional increase of longline landings from the early to mid-1990s is directly due to a significant decrease in gill net landings (Table 9).

In 2000, the Massachusetts Division of Marine Fisheries (DMF) and the Massachusetts Marine Fisheries Commission approved a daily possession limit of up to 7,000 pounds for spiny dogfish caught in state waters. DMF also prohibited overnight gill net sets for spiny dogfish to minimize regulatory discarding by that gear type. Federal regulations require possession limits of 600 or 300 pounds, depending on the season, for federally-permitted vessels fishing in both federal and state waters. Vessels participating in the Massachusetts state water spiny dogfish fishery must turn in their federal spiny dogfish permit if they wish to catch and land the higher dogfish possession limit in Massachusetts state waters. Consequently,

vessels without federal permits dominate the Massachusetts landings. These include vessels rigged for longlining and gill netters that are willing to fish short soaks for the 7,000 pound possession limit.

Once spiny dogfish schools are located, spiny dogfish gill netters make snap sets with sink gill nets and usually retrieve their nets within an hour. Longline dogfish fishermen usually set up to 1,000 hooks in a string and retrieve their gear within one to two hours after they set. The spiny dogfish longline fishery has almost no bycatch, based on state observed trips done in 2000-2001.

Table 9. Percent Annual Landings by Gear for the Massachusetts Spiny Dogfish Commercial Fishery.

Year	Longline	Gill Net	Trawl	Hand Line	Other	Total
1988	0.00%	48.23%	51.77%	0.00%	0.00%	100.00%
1989	0.02%	81.00%	18.98%	0.00%	0.00%	100.00%
1990	0.00%	52.65%	47.35%	0.00%	0.00%	100.00%
1991	0.00%	72.86%	27.14%	0.00%	0.00%	100.00%
1992	0.09%	67.41%	29.54%	0.22%	2.73%	100.00%
1993	1.92%	62.40%	35.65%	0.02%	0.01%	100.00%
1994	4.43%	76.02%	19.12%	0.02%	0.42%	100.00%
1995	10.66%	78.18%	10.48%	0.07%	0.60%	100.00%
1996	10.50%	80.68%	8.15%	0.04%	0.63%	100.00%
1997	10.76%	81.32%	7.60%	0.14%	0.17%	100.00%
1998	9.71%	78.58%	10.75%	0.57%	0.39%	100.00%
1999	21.25%	71.08%	7.03%	0.12%	0.53%	100.00%
2000	67.92%	29.67%	2.13%	0.23%	0.04%	100.00%
2001	71.91%	25.45%	2.03%	0.25%	0.36%	100.00%

Source: Unpublished NMFS Weighout Data.

While DMF's rules allow a higher possession limit, the overall seasonal dogfish quotas were honored in 2001. The seasons were short and closed within one or two months of each seasonal opening date (May 1 and November 1). In 2001, the fishery began in May and closed in mid-June when the seasonal quota was harvested. Though dogfish are present in state waters and adjacent federal waters, fishing is prohibited until the fall/winter quota period opens in November. Spiny dogfish arrive in state waters during May and usually depart by December.

With increased groundfish restrictions, small gill netters and small longline boats that cannot do offshore trips to open grounds have found the spring/fall dogfish fishery to be an integral part of their fishing year. Most commercial landings are from trips prosecuted in the southern part of Massachusetts Bay and Cape Cod Bay as well as waters east of Cape Cod. The primary ports for spiny dogfish landings are Chatham, Plymouth, and Scituate.

Fishermen and dealers noted the following recent local trends in state waters at the major dogfishing ports, which also parallels the overall state landings trend from NMFS weighout data. In Chatham, 70% of the spiny dogfish landings were contributed by gill nets and 30% are from longline gear. Since 2000, 85% of the Chatham dogfish landings are from longlines and 15% are from gill nets. The gear change is due to many gill netters leaving the directed dogfishing. Since 2000, 75% of the Plymouth spiny dogfish fishery was landed by longliners and 25% were landed by gill netters. Prior to 2000, gill netters dominated the Plymouth landings. Scituate has seen the smallest change in the proportion of dogfish landed by gear type. Prior to 2000, gill netters landed 75% of the spiny dogfish and longliners landed 25%. Since 2000, the proportion of spiny dogfish landed by longliners has increased compared to the gill netters, 35% and 65% respectively.

Prior to the implementation of the interstate FMP, the dogfish processing industry in Massachusetts was comprised of three plants located in New Bedford, which processes nearly the entire eastern US coast dogfish catch and a part of the Canadian landings. Hundreds of jobs are presently associated directly and indirectly with the dogfish processing industry in Massachusetts. Since the state of Massachusetts restricted daily dogfish possession limit in 2000, processors report the catch is in better shape, fishermen are getting a steady favorable price, and processors can better predict the amount of product they will receive daily based on the number of boats out that day.

1.3.1.2 North Carolina Commercial Spiny Dogfish Fishery

Spiny dogfish can be found along the entire North Carolina coast from November to April. North Carolina's spiny dogfish fishery began during the early 1990's when sink gill net fishermen who traditionally targeted bluefish (*Pomatomus saltatrix*), weakfish (*Cynoscion regalis*), and Atlantic croaker (*Micropogonias undulatus*) switched to harvesting dogfish (Gearhart 2000). The North Carolina spiny dogfish fishery started in November and lasted until April and primary ports for the fleet were Wanchese and Hatteras (Figure 6). Approximately 25 boats primarily targeted spiny dogfish out of Hatteras and Oregon Inlet in the mid 1990's, but less than 15 boats remained by 1999 (Hickman et al. 2000). Local fishermen who would occasionally target spiny dogfish focused their effort on other species while other fishermen left the ocean gill net fishery altogether (Gearhart 2000; Batsavage and Burns 2001).

The peak catches occurred in February and March, which coincided with the beginning of the annual northward migration of the species (Batsavage 2001). The majority of the spiny dogfish fishery occurred from Oregon Inlet to Ocracoke Inlet. Spiny dogfish fishing also took place from Cape Lookout to Bogue Inlet in February and March, but fishing effort for spiny dogfish was low west of Bogue Inlet to the South Carolina border, despite their common presence (Thorpe and Beresoff 2000). North of Cape Hatteras the fishery operated one to twenty miles offshore. South of Cape Hatteras the fishery took place primarily within state waters (Thorpe and Beresoff 2000).

Gill nets accounted for 95% of the annual harvest in North Carolina (Table 10) (Batsavage 2001). There were two different gill net fisheries, the anchored nets and the drop net fishery. The anchored gill nets are set in the late afternoon and usually retrieved the next day. Soak times for anchor nets were usually from 12 to 22 hours, but due to weather conditions, the nets may soak for 2-3 days because fishermen could retrieve them sooner (Gearhart 2000; Batsavage 2001). In the drop net fishery, schools of fish are located with sonar, then the nets are deployed over the school of fish and retrieved several hours later. Soak times for drop sets average only 3 hours (Gearhart 2000). The nets are weighted to prevent drifting. The mesh and twine ranges for the spiny dogfish ocean sink gill net fisheries are 5 – 6 ½ inches stretched mesh and 0.62 - 1.05 mm twine. Mesh sizes between 5 ½ and 6 inch were most commonly used in the spiny dogfish fishery, but vessels usually carry more than one mesh size net to fish for two or three different target species during a trip (Gearhart 2000).

From 1989-1993, the coastwide landings data indicated that 88-95% of spiny dogfish were harvested in federal waters (> 3 miles) (MAFMC and NEFMC 1998). Since the mid-1990s, fishing effort shifted into state waters (< 3 miles) off North Carolina. In 1994, North Carolina began a trip ticket program to record the number of trips, landings, and location of the fishery (i.e. state v. federal waters) (Batsavage 2001). The number of gill net directed trips targeting spiny dogfish peaked in 1996 at 2,288 trips and steadily declined to only 889 trips during the last year of a directed fishery (Table 11). From 1995-2000, 60% of the directed spiny dogfish gill net trips were made in state waters. Effort in state waters increased from 53-55% of the trips in 1995 and 1996 to 62-66% of the trips from 1997-2000. Most of the spiny dogfish fishery occurred within 5 miles from shore, so the concentration of effort was along the state-federal water boundary (Gearhart 2000; Batsavage 2001). This made it feasible for a particular fishing trip to have nets set in both state and federal waters on the same day. Likewise, it is possible that trips taking

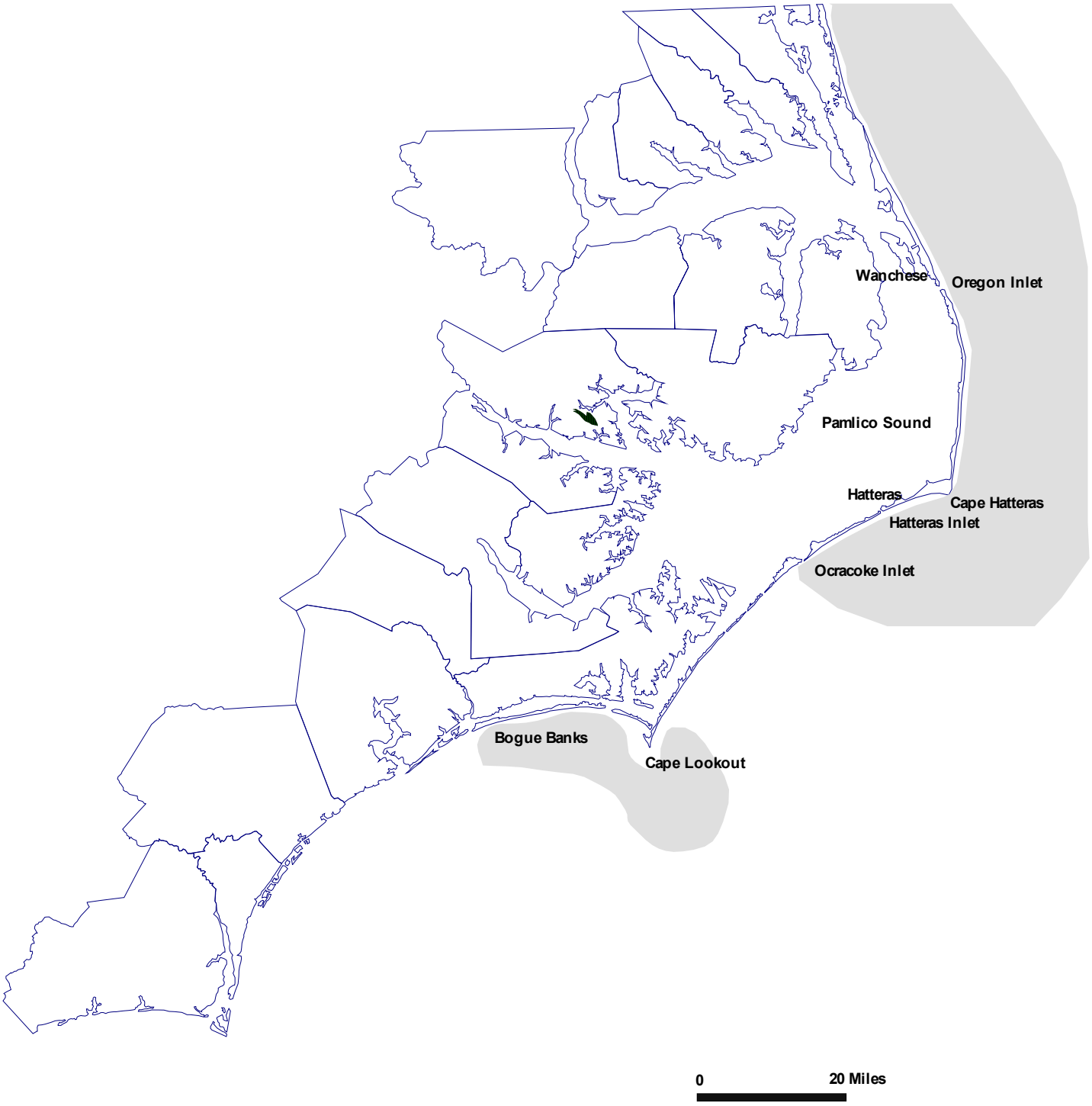

Figure 6. Spiny dogfish ocean gill net fishing grounds of North Carolina.

Table 10. Spiny dogfish landings (pounds) by all fishing gear and the sink gill net fishery (percent of the total landings indicated in brackets) of North Carolina from 1988-2001.

Year	Total Landings - All Gears	Sink Net Fishery Landings
1988	301,000	.
1989	.	.
1990	41,000	.
1991	1,463,221	.
1992	8,634,923	.
1993	8,806,064	.
1994	9,877,661	.
1995	7,174,803	7,039,675 (98%)
1996	13,210,735	12,722,121 (96%)
1997	7,608,426	7,305,620 (96%)
1998	4,961,379	4,648,785 (94%)
1999	3,718,628	3,455,990 (93%)
2000*	3,546,205	3,339,657 (94%)
2001**	373	373 (100%)

Source: Landings from 1988-1994 from NMFS weighout data in federal spiny dogfish FMP. Landings from 1995-2000 from the North Carolina Division of Marine Fisheries Trip Ticket Program.
*Fishery closed by state proclamation authority on October 20, 2000.
**Fishery closed by state proclamation authority on November 30, 2001.

place just beyond 3 miles may be classified as "state waters" on the trip tickets. Therefore, it is difficult to distinguish whether many of the trips targeting spiny dogfish occurred in state or federal waters.

Trends in landings were very similar to the effort trends for the same period. Annual landings of spiny dogfish from the ocean gill net fishery peaked in 1996 at approximately 12.7 million pounds (Table 11). Landings sharply decreased each of the following years to only 3.3 million pounds in 2000. Annual landings in state waters from 1995-2000 averaged about 3.4 million pounds compared to just over 3.0 million pounds in federal waters. The proportion of spiny dogfish landed in state waters increased from 47-50% in 1995 and 1996 to 56-58% from 1997-2000 and remained relatively stable. The catch per unit effort (CPUE) declined similarly to landings and effort except for a slight increase in 2000. Although more pounds of spiny dogfish were landed in state waters, CPUE was greater in federal waters. The average CPUE in federal waters was 5,160 pounds, compared to 3,835 pounds in state waters.

The number of non-target ocean gill net trips that incidentally landed spiny dogfish showed the same trend as the directed trips with the number of trips peaking in 1996 and steadily declining during the following years (Table 12). From 1995-2000, 55% of the non-target trips landing spiny dogfish occurred in state waters. The proportion of trips incidentally landing spiny dogfish in state waters decreased from 51-48% in 1995 and 1996 to 58-60% from 1997-1999; only 50% of these non-target trips with spiny dogfish were in state waters in 2000. Trends in landings exhibited a similar pattern between state and federal waters as the trips. The average landings of spiny dogfish caught as a bycatch in the ocean gill net fishery was approximately even between state and federal waters. Overall landings generally showed a slow declining trend from 1996-1999 with a slight increase in 2000. Incidental landings in state waters peaked in 1997 with over 97,000 pounds harvested. Incidental landings in federal waters peaked in 1996 at over 108,000 pounds and declined to less than 56,000 pounds in 1999. However, landings increased to over 91,000 pounds in 2000. From 1995-2000, the CPUE was higher in federal waters than state waters.

Table 11. Number of trips targeting spiny dogfish and pounds landed in state and federal waters statewide, North of Cape Hatteras, and South of Cape Hatteras. Percentages of trips and pounds landed in state and federal waters in parentheses.

	State waters			Federal waters			Overall		
			CPUE			CPUE			CPUE
Year	Trips	Pounds	(lbs./trip)	Trips	Pounds	(lbs./trip)	Trips	Pounds	(lbs./trip)
1995	694 (53%)	3,336,329 (47%)	4,807.40	612 (47%)	3,703,346 (53%)	6,051.20	1,306	7,039,675	5,390.30
1996	1,268 (55%)	6,350,268 (50%)	5,008.10	1,020 (45%)	6,371,853 (50%)	6,246.90	2,288	12,722,121	5,560.40
1997	1,178 (66%)	4,212,492 (58%)	3,576.00	616 (34%)	3,093,128 (42%)	5,021.30	1,794	7,305,620	4,072.30
1998	777 (64%)	2,589,465 (56%)	3,332.60	433 (36%)	2,059,320 (44%)	4,755.90	1,210	4,648,785	3,842.00
1999	626 (62%)	1,945,896 (56%)	3,108.50	378 (38%)	1,510,094 (44%)	3,995.00	1,004	3,455,990	3,442.20
2000	588 (66%)	1,868,113 (56%)	3,177.10	301 (34%)	1,471,544 (44%)	4,888.90	889	3,339,657	3,756.60
2001	0 (0%)	0 (0%)	0.0	0 (0%)	0 (0%)	0.0	0	0	0.0
95-'00 Average	855 (60%)	3,383,760 (53%)	3,835.0	560 (40%)	3,034,881 (47%)	5,159.9	1,415	6,418,641	4,344

Source: North Carolina Trip Ticket Data.

Table 12. Number of non-target trips that harvested spiny dogfish and pounds landed in state and federal waters statewide, North of Cape Hatteras, and South of Cape Hatteras. Percentages of trips and pounds landed in parentheses.

	State Waters			Federal Waters			Overall		
			CPUE			CPUE			CPUE
Year	Trips	Pounds	(lbs./trip)	Trips	Pounds	(lbs./trip)	Trips	Pounds	(lbs./trip)
1995	83 (51%)	15,261 (44%)	183.9	79 (49%)	19,258 (56%)	243.8	162	34,519	213.1
1996	258 (48%)	78,692 (42%)	305.0	275 (52%)	108,258 (58%)	393.7	533	186,950	350.8
1997	304 (58%)	97,661 (54%)	321.3	217 (42%)	83,909 (46%)	386.6	521	181,570	348.5
1998	274 (60%)	85,712 (56%)	312.8	186 (40%)	66,472 (44%)	357.4	460	152,184	330.8
1999	258 (60%)	78,510 (58%)	293.8	175 (40%)	55,590 (42%)	317.7	433	134,100	303.5
2000	189 (50%)	72,875 (44%)	385.6	187 (50%)	91,411 (56%)	488.8	376	164,286	436.9
2001	2 (67%)	360 (97%)	180.0	1 (33%)	13 (3%)	13.0	3	373	124.3
95-'00 Average	228 (55%)	71,452 (50%)	300.4	187 (45%)	70,816 (50%)	365	414	142,268	330.6

Source: North Carolina Trip Ticket Data.

The overall CPUE from 1995-1999 also showed a slow declining trend with an increase of over 100 pounds per trip from 1999 to 2000.

Although landings of incidentally caught spiny dogfish showed similar trends as the directed fishery, the mesh sizes and locations of the other fisheries limited these landings. Ocean gill net landings of Atlantic croaker (*Micropogonias undulatus*) and weakfish (*Cynoscion regalis*) were concentrated in the same area as directed spiny dogfish landings. However, the mesh sizes (3-4.5 in stretch mesh) used to target these species is smaller than the mesh sizes (5.5-6.5 in) used to target spiny dogfish (Gearhart 2000; Hickman et al. 2000; Newman et al. 2000; Batsavage and Burns 2001). Therefore, the spiny dogfish caught were generally smaller and fewer were caught per trip. The ocean gill net fishery for large bluefish (*Pomatomus saltatrix*) uses identical mesh sizes as the spiny dogfish fishery and occasionally possessed a significant amount of spiny dogfish in their catches. But much of the fishing effort occurred over 30 miles offshore of Oregon Inlet where spiny dogfish are not always present.

The majority of North Carolina's landings from 1996-2000 would fall under the jurisdiction of the ASMFC due to the shift in directed effort to state waters combined with the incidental harvest of spiny dogfish while targeting other species. Coordinated management of this species would facilitate enforcement because spiny dogfish are commonly found both nearshore and offshore with much of the fishing took place on the boundary between state and federal waters.

1.3.1.3 Biomedical Industry/Scientific Research

Maine

The Mount Desert Island Biological laboratory (MDIBL) was founded in 1898 at South Harpswell, Maine by J.S. Kingsley of Tufts University. The lab moved to its present site in Salsbury Cove on Mt. Desert Island in 1921. The laboratory was incorporated in 1914 under the laws of the State of Maine as a nonprofit and educational institution. Its original purpose was to teach undergraduate marine biology, but soon expanded to providing a facility for marine research as well. Pioneering work by H.K. Smith, E.K. Marshall and Roy P. Foster was directed toward various aspects of renal and osmoregulatory physiology of local fauna. The laboratory has since become known worldwide as a center for investigations in electrolyte and transport physiology, developmental biology, and electrophysiology. Examples of specimens collected annually for laboratory research include sea cucumber, little skate, winter skate, longhorn sculpin, and spiny dogfish.

In the early 1960's it was discovered that dogfish have a unique organ called a rectal gland. This organ secretes nearly 100% sodium chloride and is critical to the osmoregulatory function in dogfish. Extensive research has been conducted on dogfish rectal glands to better understand human kidney functions. Dogfish also exhibit peculiar immune properties that strongly resist infection. This species possesses a molecule known as squalimine that has strong antibiotic characteristics. Biomedical studies and research are ongoing to test the efficacy of this molecule as an anti-cancer agent. Fresh spiny dogfish specimens are necessary to carry out biomedical research at MDIBL. A permit is issued annually by Maine DMR to allow collection of specimens for lab research. The number of specimens required rarely approaches 2,000 animals per year and normally numbers less than 1,000. Either sex is satisfactory for current uses and MDIBL staff have concentrated on use of males only in recent years due to the depleted status of Atlantic coast spiny dogfish. Specimens are collected by trawl in waters adjacent to Mt. Desert Island as well as in mid-coast Maine around John's Bay and 5-10 miles south of Pemaquid Point (just northeast of Portland, ME).

North Carolina

There are some biological supply companies in North Carolina that purchase spiny dogfish directly from fishermen and in turn are sold to high school and college level biology courses as preserved specimens. These companies have purchased spiny dogfish since the early 1980's before the directed commercial

fishery. Spiny dogfish not sold as preserved specimens were used for biomedical research on the rectal glands.

All sizes and both sexes of spiny dogfish were purchased for specimens. They were graded as small (<24"), medium (24-27"), large (>27") and pregnant. Small sized dogfish were not purchased because the commercial fishery directed their effort on the medium, large and pregnant spiny dogfish.

One of the companies in North Carolina explained that it was capable of processing about 200 spiny dogfish per day for use as preserved specimens (Woodard, personal communication). The most spiny dogfish this company purchased in a year (it has not purchased any since 2000) was 10,000 fish or approximately 50,000-60,000 pounds. In contrast, a national supplier can accommodate a larger capacity, processing over 16,000 pounds of dogfish in a 4-hour period or 150,000 pounds in one year (Carolina Biological Supply, 2002). In the US, there are about 400,000-500,000 pounds of spiny dogfish purchased annually for use as preserved specimens (Wards Natural Science, personal communication). Because of spiny dogfish closures on the East Coast, biological suppliers are now purchasing spiny dogfish from the West Coast and the Canadian Maritimes.

Spiny dogfish have been purchased directly from the commercial fishermen fishing ocean gill nets in southeastern North Carolina. These fishermen target weakfish and sea mullet (*Menticirrhus sp.*) in state waters and sell their bycatch of spiny dogfish. In addition to purchasing spiny dogfish directly from the commercial fishermen in southeastern NC, another avenue is to purchase spiny dogfish from seafood wholesalers in northeastern NC.

There are no feasible substitutes for spiny dogfish in the preserved specimen market. The closest substitute for preserved specimens is smooth dogfish between 18 and 24". Because they differ anatomically from spiny dogfish, there is a limited market for them. Another potential substitute purchased by some companies are Cuban dogfish (*Squalus cubensis*) in lieu of spiny dogfish, but they are not caught consistently because they are a deep water (> 100 fathoms) species occasionally retained in the offshore longline fishery.

1.3.1.4 Social and Economic Characterization of the Commercial Fishery

In order to reduce some of the fishing pressure on collapsed groundfish stocks, efforts were made in the late 1980's to create and promote markets for spiny dogfish, and to develop a directed spiny dogfish fishery. As a result, landings and ex-vessel values of spiny dogfish increased substantially throughout the early- and mid-1990's. Ex-vessel values increased from $483,000 in 1988 and peaked at $10,921,000 in 1996 before declining to $4,383,000 in 2000 (Table 13). Implementation of a federal quota in May 2000 and subsequent ASMFC Emergency Action in August 2000 contributed to the reduced landings and ex-vessel value in 2000. Ex-vessel values for 2001 are unavailable as of this writing, though they are expected to be considerably reduced from 2000 due to the quota reduction.

Average ex-vessel price fluctuated with an increasing trend throughout the late 1980's and into the mid-1990's, increasing from $.07 per pound in 1988 to $.19 per pound in 1995 (Table 13). After a slight decrease in price per pound in the late 1990's, average ex-vessel price reached a peak of $.23 per pound in 2001. Presumably this increase was a result of reduced supply owing to the quota restriction.

Massachusetts has dominated spiny dogfish landings and ex-vessel value coast-wide since 1988, followed by North Carolina and Maryland with additional significant contributions by Maine in the late 1980's, New Jersey in the 1990's, Virginia in the late 1990's, and New Hampshire in 2000. The following is a comparison of ex-vessel value by state for 1994-2000, adjusting the values by the producer price index for fish products to 2000 dollars (BLS 2002) (Table 15). The 1994-2000 period is used because 1994 is generally thought to be the first year of the modern dogfish fishery.

Table 13. Ex-vessel values and price per pound of spiny dogfish commercial landings by year, Maine - North Carolina.

Year	Value ($1,000)	Price (Mean)
1988	483	0.07
1989	860	0.09
1990	3,313	0.10
1991	2,692	0.09
1992	3,943	0.11
1993	5,567	0.12
1994	5,588	0.14
1995	9,138	0.19
1996	10,922	0.18
1997	6,808	0.15
1998	7,857	0.17
1999	5,417	0.16
2000	4,338	0.21
2001	1,139	0.23

Source: Unpublished NMFS Weighout Data and South Atlantic General Canvass Data.

Massachusetts, North Carolina, and Maryland represent over two-thirds of the ex-vessel value during the entire time period. Connecticut and Delaware only have landings during 1995 and these are small. Ex-vessel value peaked in Massachusetts in 1995 at $6.08 million. Ex-vessel value in 1999 is only 41% of 1995 levels. In North Carolina, ex-vessel value peaked in 1996 at $2.63 million and 1999 ex-vessel value is only 21% of the 1996 level. Ex-vessel value peaked at $1.86 million in 1996 in Maryland and declined to 20% of 1996 levels in 1999. In 1999, the ex-vessel values in Maine were only 3% of 1995 levels. These declines should be contrasted with increases in ex-vessel value over time in other states. Ex-vessel value peaked in 1998 in Rhode Island and New Jersey. In both states, 1999 values are significantly greater than during the mid-1990s. 2000 is the peak year for New Hampshire and New York with a 175% and 61% increases in ex-vessel value over 1999, respectively. Rhode Island ex-vessel value peaks in 1998 and declines by 32% in 1999. With the implementation of the federal quota, ex-vessel values in 2000 are relatively low for Maine, Massachusetts, Rhode Island, Maryland, Virginia, and North Carolina. Surprisingly, ex-vessel value in New Jersey is only 15% lower than the peak year.

The processing sector was founded in New Bedford, MA. Processing of spiny dogfish must occur within 48 hours of harvest in order to maintain the quality of the product. Spiny dogfish processing requires skilled laborers and specialized equipment, and must maintain a critical volume in order to be profitable. Most processors of other species can not occasionally supplement with spiny dogfish. Some smaller spiny dogfish processors in Virginia, for example, were forced to close or diversify beginning in 2000 due to the restricted harvests. Consequently, spiny dogfish harvested south of Massachusetts are trucked to New Bedford for processing. During the peak harvest years, processors in New Bedford employed hundreds of laborers and deployed dozens of trucks to southern states to pick up spiny dogfish. Today, US spiny dogfish processing is limited to New Bedford, MA, and Portsmouth, NH.

Table 14. Ex-vessel values ($1,000's) of commercial landings of spiny dogfish by year and state.

											1998	1999	2000	2001
ME	59	430	745	188	203	509	264	338	169	68	46	8	2	0
NH			21		50	252	365	397	190	146	350	206	605	148
MA	359	405	1596	1,145	2,186	3,541	3,394	5,413	4,934	3,120	4,299	2,317	1,335	866
RI			115	292	226	213	68	109	212	142	276	196	63	65
CT			2		1	1	10	19	133	48	48	13	6	1
NY	21	14	3	16	27	24	64	187	258	97	231	221	361	19
NJ	1	2	582	428	243	90	174	502	939	697	1,104	679	979	2
DE				4				12	-	-	3	1	-	0
MD	4	1	238	476	294	188	192	883	1,540	781	354	352	86	0
VA	1		2	17	19	9	40	125	401	726	495	913	304	37
NC	36	6	3	122	691	735	1,011	1,147	2,146	985	651	511	598	0

Source: Unpublished NMFS Weighout Data.

Table 15. Spiny dogfish estimated annual ex-vessel value, by state (2000 dollars).

	ME	NH	MA	RI	CT	NY	NJ	DE	MD	VA	NC	TOTAL
1994	$316,307	$479,357	$4,111,644	$51,476			$72,562			$37,187		$5,068,533
1995	$342,817	$456,658	$6,082,999	$20,779	$19,411		$155,773	$14,441	$999,286	$29,138	$1,317,487	$9,438,791
1996	$200,633	$232,183	$6,044,533	$200,052		$18,098	$195,884		$1,863,050		$2,628,421	$11,382,854
1997	$80,025	$172,118	$3,683,766			$1,420	$678,220		$923,028		$1,162,112	$6,700,688
1998	$50,144	$396,234	$4,858,200	$310,370		$1,720	$1,145,636		$400,542	$524,288	$735,560	$8,422,694
1999	$9,055	$220,353	$2,483,323	$210,023		$223,111	$727,042		$372,444	$904,660	$547,255	$5,697,268
2000	$1,777	$604,980	$1,335,411	$49,719		$359,545	$978,612		$85,436	$273,770	$595,743	$4,284,993
Total	$1,000,759	$2,561,883	$28,599,877	$842,418	$19,411	$603,893	$3,953,729	$14,441	$4,643,786	$1,769,043	$6,986,579	$50,995,820
1994-1998 average	$197,985	$347,310	$4,956,229	$145,669	$19,411	$7,079	$449,615	$14,441	$1,046,477	$196,871	$1,460,895	$8,841,982

Source: Unpublished NMFS Weighout Data

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Fishing Communities

Spiny dogfish have been caught by fishermen for generations, though it was not until foreign markets were developed for spiny dogfish in the early 1990s that fishermen began to target them in significant quantities. In the mid to late 1990s as the spiny dogfish fishery peaked, a number of fishermen and processors had invested their efforts and capital in the dogfish fishery, to the point where some fishing ports and communities had come to rely on spiny dogfish as a significant percentage of the fishing industry.

In 1997, at nearly the peak of the spiny dogfish fishery, the following ports derived a large percentage of the total (all species combined) landings value from spiny dogfish (Table 22). In Plymouth, MA, spiny dogfish accounted for 96% of the total pounds and 74% of the total value of all fish landed in this port. In Wachapreague, VA, spiny dogfish accounted for 90% of the total pounds and 76% of the total value of all fish landed in that port. In Scituate, MA, spiny dogfish accounted for 74% of the total pounds and 21% of the total value of all fish landed in this port. In Chatham, MA, spiny dogfish accounted for 47% of the total pounds and 14% of the total value of all fish landed in this port. In Ocean City, MD, spiny dogfish accounted for 32% of the total pounds and 11% of the total value of all fish landed in this port. In Dare County, NC, spiny dogfish accounted for 30% of the total pounds and 11% of the total value of all fish landed in this county (MAFMC 1999).

The MAFMC *et al*. (2002) states:

"According to 2000 unpublished NMFS weighout data, most ports now derive a lower percent of landings value from spiny dogfish since FMP implementation (as compared to the combined value of all other species landed in that port). The port most dependent on spiny dogfish since FMP implementation was Rye, NH where spiny dogfish accounted for 38% of the total pounds and 13% of the total value of all fish landed in this port in 2000. In Oyster, VA, spiny dogfish accounted for 34% of the total pounds and 11% of the total value of all fish landed in that port in 2000; in Hatteras, NC, spiny dogfish accounted for 34% of the total pounds and 9% of the total value of all fish landed in this port in 2000; in Chatham, MA, spiny dogfish accounted for 34% of the total pounds and 9% of the total value of all fish landed in this port in 2000; in Chincoteague, VA, spiny dogfish accounted for 22% of the total pounds and 8% of the total value of all fish landed in this port in 2000; and, in Portsmouth, NH, spiny dogfish accounted for 24% of the total pounds and 7% of the total value of all fish landed in this port in 2000.

"Clearly, some of these ports were disproportionately affected by regulatory actions imposed under the FMP. The extent to which local communities were affected 'materially' is unknown, but it is likely that some of the local business which support the commercial fishing industry in these areas were adversely impacted by these actions in the short-term."

The following community descriptions focus on ports where spiny dogfish comprised a significant portion of the total species landings in those ports in 1997 and/or 2000, arranged geographically from north to south by state.

Rye, NH

Hall-Arber et al. (2001) writes:

"In the 1850's a quarter of Rye's population was dependent upon fishing, but in the latter part of the 19th century, its economy gradually became increasingly reliant on the tourist industry. By the 1960's there was little finfishing effort, most fishermen were engaged in lobstering. There was a surge of interest in fishing after the passage of the Magnuson Act (1976) when some of the lobster fishermen turned to gill netting, but restrictions have diminished their numbers. Today, Rye has 24 or more boats, 8-10 groundfish and over 12 lobster boats that use the commercial pier. Their catches (including shrimp) are usually unloaded and trucked to the co-op in Portsmouth. Rye's significance as a fishing port is heightened due to its proximity to fertile fishing grounds. It has the 'shortest run to significant fishing

grounds' compared to other ports in the region. New Hampshire Commercial Fishermen's Association is also based in Rye."

Rye was characterized as the port most dependent on spiny dogfish since the implementation of the federal FMP (based upon 2000 unpublished NMFS weighout data). After the implementation of the federal regulations, the spiny dogfish landings in Rye, NH accounted for 11% more of the total landings for the port. Spiny dogfish also provided 10% more in total ex-vessel value.

Portsmouth, NH

Hall-Arber et al. (2001) writes:

"Portsmouth is the site of the primary fishing fleet of New Hampshire, which is supported by a state pier and adjoining fish co-op. The pier lies adjacent to historic buildings, restaurants, and museums touting the past and celebrating the present total capital flows of this industrious port city. The support of the fishing industry by the city reflects the view that the commercial fishing industry is an important component in both the diversification of the local economy and provision of cultural color that makes the waterfront attractive."

"The co-op, built in 1978, is the nerve center of most fishing activity, with the exception of the local lobster fleet. No lobsters are landed at the state pier, but are landed at a smaller pier to the south, and in several other areas, by more than 50 full time lobster fishermen. The co-op has members as far away as York, Maine. In fact, one respondent suggested that York County is more closely related to Portsmouth than it is to Portland (Maine).

"Most of the product landed at the co-op is finfish, as well as some scallops, sea urchins and conch. Shrimp from boats in Rye is trucked to the Portsmouth Co-op. Lots of fish brought into the co-op ends up on the auction in New Bedford, Portland or Gloucester. Some also is sold directly to brokers such as North Shore Seafood in Boston. There are also three trucking brokers working out of Fultons' market in New York, and the co-op sells to them 'practically every night'." Spiny dogfish are only one of at least 29 species landed in Portsmouth, including groundfish, pelagic and highly migratory species, crustaceans, and other finfish.

"Today the economic condition of the fishery is rated as poor, with the perception that there are more fish to be caught, since they are having to waste many hundreds of pounds of cod by throwing them back in (since this survey, the daily catch limit has been raised from 100 lbs. to 400 lbs.).

"For 'five years from now', the prognosis is 'excellent', with the condition that management will allow people to fish by opening up closed areas and increasing allowable Days at Sea. A mitigating factor is the increased price on landed fish, in part due to the increasing use of the fish auction system that emphasizes quality of product over quantity. Fish species caught are highly varied, and the fish broker makes it a policy to buy everything that comes in, even if he has no immediate market for it. That insures that the fishermen are able to at least break even, even though it may dampen the eventual profit collected by the co-op broker."

Scituate, MA

Hall-Arber et al. (2001) writes:

"…Scituate is a small to mid-sized seacoast community located equidistant between Boston and Plymouth…Scituate sits on the edge of a harbor, once filled with commercial fishing vessels, but now being transformed into a gentrified community with a struggling fishing presence…Four mid-sized stern trawlers, 2 full-time and 2 part-time, hail from Scituate…There are 5 active full-time gill-netters and one part-time. About 50 lobster boats are also based in Scituate. Before the groundfish regulations were implemented there were 15 to 18 draggers and many of the vessels that now go lobstering were hook

boats…[Neighboring] Marshfield has 75 to 100 including 15 charterboats…The boats are primarily tuna, lobster, or combination boats (lobstering, scalloping, dragging depending on the season). Dogfish was a staple for awhile, but recent regulations have ruined that fishery…Scituate dock sits on the landward side of two protected coves, and has little remaining fishing infrastructure. There is no fish processor, ice house, bait house, fish auction, boat builder, net maker, or seafood broker in Scituate…[There are] five fishing associations (two for lobster fishing, and the other three for finfishing) to which fishermen from Scituate belong…Two niche fisheries were tried for awhile, that is, slime eels (hagfish) and live sea ravens. Neither is currently active. The dogfish fishery was also active for a time…After markets for dogfish developed, they were caught June through November."

Located north of Cape Cod and south of the City of Boston, the fishing fleet in this port is comprised of primarily gill net boats (approximately 85%) (MAFMC *et. al*. 2002). Reportedly most of the landings at Scituate and some of the landings in Plymouth (located to the south) can be attributed to these dogfish harvesters. Dogfish are unloaded and transported to processing facilities by 3-4 different carriers and ice is supplied primarily by one local business.

Plymouth, MA

Hall-Arber et al. (2001) writes:

"Plymouth is a coastal community in southeastern Massachusetts, approximately 5 miles north of the Cape Cod Canal…While Plymouth attracts thousands of tourists at the height of the summer season, the town maintains a diverse fishery sustained in part by the protection of docking space for the local fleet…Fishery dependence centers on the lobster fleet with its 50 operating vessels. There are also four stern draggers and four gill-netters concentrating on dogfish, but this effort represents a significant decline from about 30 boats that were dogfishing less than five years ago. Lobster boats range from 19 to 42 feet in length, and draggers 45 to 55 feet in length…Lobster makes up the primary catch in Plymouth today, with finfish species remaining important, though many fewer boats pursue finfish than did so in the past. Local species fished include cod, flounders, dabs, winter flounder, yellowtail, gray sole, tuna, striped bass, dogfish, skate, monkfish, bluefish, scallops, and seaweed…It used to be that most fishermen would do some cod fishing, gill netting, even jigging, when not lobstering, but restrictions have meant that most fishermen rely solely on lobsters now…Recent fishery regulations having the most impact are groundfish closures, which has forced some fishermen into the lobster fishery."

Located to the south of Scituate and featuring a slightly smaller fishing fleet, Plymouth boats are comprised of about 40% gill net boats (MAFMC 2002). Reportedly, 1-2 different carriers transport dogfish from the port to processing facilities with the aid of one local business that acts as something of a broker. Ice is also provided locally.

Chatham, MA

Chatham occupies the southeastern corner of Cape Cod. Like Wachapreague, Chatham provides sheltered harbors behind a string of barrier islands, and has a long-standing tradition of fishing and marine-related activities (Peter Fricke, personal communication).

Chatham can be said to be substantially dependent on and engaged in fishing to meet the economic and social needs of its year-round population. With regard to spiny dogfish, approximately a third of the 87 larger vessels operating from Chatham participate in the dogfish fishery (Peter Fricke, personal communication). However this large volume fishery is of low value (14 percent of the value of all finfish landings; 9.6 percent of the value of all commercial landings). Since it is reported that much of the landings of dogfish in Chatham are processed elsewhere, it would appear the town does not capture the full benefits of the dogfish fishery. While the vessels involved in the fishery appear to be substantially dependent on the fishery, dogfish is a replacement for other, higher-value, fisheries which have been depleted in the annual round of fishing activities of the vessels in question. As stock composition

changes so will the dependence of these vessels on spiny dogfish as a target species. In the short-term, however, closure of the directed fishery will impact some 28 vessels and 90 fishermen immediately, and two of the three processors will lose some volume and value of sea food processed (Peter Fricke, personal communication). Since most Chatham vessels are family owned and operated, and many crews have kinship ties, the social and cultural impact would be amplified at the level of fishing families.

From 1995 to 2000, Chatham has led all Atlantic coastal ports in terms of total annual ex-vessel value of spiny dogfish. In this port, the spiny dogfish landings have decreased to 13% of the total landings from 1997-2000. During this same period, the ex-vessel value derived from spiny dogfish declined 5%.

Point Judith, RI

Point Judith is almost exclusively a fishing community, having a core group of fishermen who fish full-time. During the summers, the streets are filled with tourists coming or going on the Block Island ferry. Yet there is little for tourists to do in Point Judith. The town does not have the condominiums, shops, and hotels that other ports such as Chatham, Newport, and Montauk have. Only on hotel stands out in Point Judith, the Dutch Inn, which is circa 1960. The few restaurants, shops, and tourists venues, such as fudge shops, are enough to take care of the summer onslaught of ferry passengers and the year round working population centered around commercial fishing (MAFMC 2002).

In 2000, Point Judith landed 59.3 million pounds with a value of $41.4 million dollars (NMFS 2000). Some of the important species for Point Judith fishermen are squid, herring, mackerel, whiting, scup, butterfish, yellowtail, summer and winter flounder (Hall-Arber et al . 2001).

Point Judith has a large fleet of trawlers, gill netters, and lobster boats. While estimates vary, approximately 200 commercial boats dock in Point Judith, including 80 trawlers, 30 gill netters, and 100 or so lobster boats (MAFMC 2002).

Point Judith fishermen are in their annual round and approach to the fisheries, as opposed to New Bedford boats which only go after groundfish. The Point Judith freezer boats are not diverse because they only target fish for frozen markets – the squids, butterfish, and mackerel. The diverse approach to fisheries combined with full-time experienced fishermen means the fishermen are fishing year round even if they may switch fisheries and boats during the year (MAFMC 2002).

Point Pleasant, NJ

McCay and Cieri (2000) write:

"Currently there is only one wholesale finfish packing dock at Point Pleasant, a fishermen's cooperative…The fisheries are very diverse, the classic situation in the Mid-Atlantic. Two stand out in terms of volume and value: otter trawls and gill netting, the latter particularly important for spiny dogfish as well as bluefish, weakfish, and other species. But sea scallop dredging is very important, as are surf clamming/ocean quahogging and offshore lobstering…Spiny dogfish have emerged as a very important fishery for the draggers and even more so for a gill-net fleet, both local and visiting, which has grown in recent years. Gill-netters have used 'runaround' nets for species such as bluefish, Spanish mackerel, little tuna, scup, and weakfish, although this gear did not appear in the 1998 NMFS data. They use drift and sink nets for dogfish, angler, bluefish, weakfish, and other species. In 1998 local fishermen using sink gill nets caught almost 17 million pounds of monkfish as well as over 8 million pounds of spiny dogfish…Declining catches and restricted fisheries have hurt this fishing community severely. Many boats have left the fishery and boats are for sale. Existing operations have difficulty investing in major improvements, either to the waterfront properties or to the vessels.

Landed value of spiny dogfish at Point Pleasant increased dramatically from $7,585 in 1996, to $296,191 in 1998 and to $654,370 in 2000. In 1998, spiny dogfish comprised 1.9% of the total pounds and 5.3% of

the total value of all species landed at Point Pleasant. Much of the total landed value was comprised of surf clam (27.5%) and ocean quahog (22.4%) (McCay and Cieri 2000). Point Pleasant ranked second behind Chatham, MA in 2000 spiny dogfish ex-vessel value.

Wachapreague, VA

Wachapreague is a small rural, non-farming community on the Atlantic Ocean side of the Eastern Shore of the Chesapeake Bay (Peter Fricke, personal communication). It lies in Accomack County and is approximately 60 miles north of Norfolk, VA and the same distance South of Salisbury, MD. Wachapreague provides a sheltered harbor behind a series of barrier islands lying offshore to the East, and is close to US 13, a major highway connecting Norfolk and the Carolinas with eastern Maryland, Delaware and Philadelphia.

Wachapreague demonstrated in 1990 the profile of a rural town with an older, retired population with some 41 percent of residents receiving income in the form of transfer payments from retirement funds and/or Social Security (Peter Fricke, personal communication). Of the employed residents of the town, only one-third works within the community. Thus approximately 70 percent of the working population earned income from sources other than the community's businesses. The businesses of the town are fishery-oriented, with respondents suggesting that direct employment and earnings in the recreational and commercial fishery sectors are split 2:1 between the two sectors. Since the recreational fishery is highly seasonal, peak employment in Wachapreague may exceed 100 jobs at the height of the summer season.

The dependence of some 20 percent of community households for income earned from fishing related activities indicates that this is a fishery dependent community economically (Peter Fricke, personal communication). It is estimated that two-thirds of this income is related to recreational fisheries and one-third to commercial fisheries. The proportion of long-term residents, fishing related community events and activities, and the number of retirees, indicate that the social and cultural needs of the population are satisfied by this water-front community and that fishing, both commercial and recreational, is substantially engaged in by the residents of the community.

Wanchese, NC

This section is adapted from McCay and Cieri (2000).

In 1990, Wanchese had 1,374 residents. Twenty percent of the community's workers were employed in 'agriculture, forestry and fishing' in 1990, the highest of the coastal communities. The relative absence of seasonal change in population for Wanchese departs from the normal pattern of seasonal variation found in the surrounding communities. Since commercial fishing is central to the economy of Wanchese, it does not see the shifts in population that occurs due to tourism in the summer months. The seasonal fluctuations that do exist in this community are caused by the availability of the fisheries resources and are countered by the flexibility and opportunistic nature of the Wanchese fishermen. This flexibility is now being threatened by decline in fish stocks and restrictions on fisheries. However, the tourism industries in the surrounding communities do provide seasonal employment opportunities to residents of Wanchese.

Throughout the nineteenth century, the commercial fishing industry expanded, due in part to the involvement of the first postmaster. This postmaster owned or financed most of the commercial fishing boats in Wanchese; he also established a system of credit for the fishermen at his store, which was paid off when they brought in their catches. During that time, almost all of the residents of Wanchese were commercial fishermen. Today, the village still revolves around fishing, but has expanded to include processing plants. Though traditionally a commercial fishing community, recent growth in tourism and recreational fishing has sparked competition between the new and the old for a restricted resource.

A central fact about fishing in Wanchese is the large number of commercially important species caught. Many respondents interviewed in 1998 emphasized how they have to be versatile to survive, particularly because they face quick changes in water temperatures and other conditions affecting fish availability. They suggest that Wanchese is much more of a mixed fishery than in the north where people can fish the same species year round. Because of the weather, summer is the time that the tunas and swordfish are accessible to the medium sized boats that can both gill net and longline, and late summer is a slow time for everything else. A captain of one of these medium size boats, however, said that he would prefer to stick with shark fishing year round because of the danger of going for tuna and swordfish farther off shore. They gill net for dogfish, bluefish, Spanish mackerel, trout, and croakers. The latter two are important in the winter and Spanish mackerel is important in the spring and fall. They bottom fish for bass and grouper. There are a number of gill net boats that switch over to charter fishing in the summer. Large trawl boats fish for squid in the summer and a smorgasbord of weakfish, croaker, and flounder in the winter. Squid requires them to travel north. There are now less than fifteen of these trawl boats that stay at Wanchese.

Hatteras, NC

This section is adapted from McCay and Cieri (2000).

Hatteras Village is a rural community at the southern end of Hatteras Island on North Carolina's Outer Banks, part of Hatteras Township (pop. 2,675 in 1990). Hatteras Island is the 'classic example' of a dynamic barrier island, which is bordered by the Atlantic on the east and Pamlico Sound on the west. Noted for it's vast marine resources, the area is also an important point of departure for marine vessels, and has historically been considered a strategic location on the coast of North America during war.

Seasonal variation in the local economy of Hatteras is due to the presence of three 'seasons'. In the spring, revenue begins to pick up during weekend and holiday tourism; it is during this period of time (April to May) that approximately 30 boats from the commercial fleet become active in charter fishing. The second season, approximately June through August, begins when schools let out for the year and family vacations are frequent. The third 'season' is the fall, when fishing, surfing and windsurfing are the dominant activities.

In Hatteras, 57% of employees are private for profit wage and salary workers. Tourism and recreation are major industries in Hatteras in terms of employment. Commercial fishing is also a major occupation on Hatteras Island, where there are approximately 500 to 600 part and full time commercial fishermen; recreational fishing is a source of seasonal employment. According to the 1990 Census, twenty-one percent of employed persons work for the local (8%), state (7%) or federal (6%) government; these public sector jobs include ferry workers. Self-employed workers make up 16% of the employed work force. When combined, managerial, professional, technician, and administrative jobs account for nearly half of the occupations reported in the 1990 Census. Farming, forestry and fishing jobs are held by 6% of those employed in Hatteras.

In Hatteras, there are five seafood wholesalers and one retail market; there are three marinas. Businesses in surrounding communities such as Manteo and Buxton also add to the marine economy. Hatteras Village is almost totally dependent on fishing. While non-fishing tourists, especially windsurfers, are attracted to beaches elsewhere on the island, Hatteras Village's own beaches are less appealing. Tourists come to Hatteras because they want to fish.

Commercial fishing in Hatteras is said to be much like that of Ocracoke in terms of the size and number of boats (30' to 45'). They mostly trawl for shrimp in the summer and "drop net in the ocean for trout" in the winter. A distinction of Hatteras is that its crabbers are said to be more conservative than those on the west banks of North Carolina: Hatteras crabbers have little more than 300 pots apiece whereas on the

western banks crabbers do not run less than 1,000 pots apiece. According to one of our informants, the more diversified nature of fishing in the Hatteras area accounts for the difference: 'Our diversity allows us to fish fewer pots.

There are three major sites for fishing boats in Hatteras: two marinas and the docks off Altoona Lane. The docks on Altoona Lane are said to service 20 to 25 crabbers and fishermen, using small boats, up to 35', as well as a couple of larger boats, including a 47' boat used for dogfish by a local fisherman.

Another dock in Hatteras is owned by a company based in Wanchese, NC. It is a very small dock, and the dock manager is the major fisherman. He dogfishes in the winter. He leases his boat because, he says, it's too risky to buy it, especially 'since we're losin' it' with regards to management of the dogfish fishery. The gill nets they use for dogfish are very expensive. He believes they could have doubled their dogfish catch if they regeared, but won't regear because of the pending regulation. They would have regeared a year ago, but they told them the regulation was coming last year, preventing them from buying new gear then. He said if they had known it wasn't coming until later this year, they would have regeared then, but now it's too late to make it profitable.

This man gill nets for dogfish in the winter. He has 1,300 yards of 4-inch mesh net for croaker. He only sets the small nets twice. He said most fishers in this area do both large and small mesh netting. In the winter they small mesh for croaker and gray trout, but these species are so plentiful then that the fish houses won't buy from the small time fishers.

1.3.2 Recreational Fishery

This section is updated from federal spiny dogfish FMP (MAFMC and NEFMC 1999).

Estimates of recreational catch and landings of dogfish were obtained from the NMFS Marine Recreational Fishery Statistics Survey (MRFSS). The recreational catch and landings data are analyzed for 1981 to 2001. There were methodological differences between the current survey and intermittent surveys conducted before 1981 that preclude the use of the earlier data.

Although dogfish are generally caught with natural bait, discard mortality for spiny dogfish can be high due to mishandling. The MRFSS provides estimates of landings in terms of numbers of fish. Biological information on dogfish is generally poor, resulting in wide annual fluctuations in mean lengths and weights. Therefore to compute total catch in weight, NEFSC (1998) assumed an average weight of 5.5 pounds (2.5 kg) per fish for all years. This assumption was used to estimate the recreational catch in pounds (Table 1).

Excluding the recreational estimate for 1981, total recreational catches (type A + B1) increased from about 150,000 pounds (70 mt) in 1982-1983 to greater than 900,000 pounds (408 mt) in 1989 (Table 16). Since then the estimates of spiny dogfish recreational catch in weight have declined. The 1993 estimate was about 265,000 pounds (120 mt). Total catch in weight declined to less than 60,000 pounds (27 mt) in 1996, but from 1997 to 1999 the catch in weight has been around 150,000 pounds (68 mt). The most recent two years available from MRFSS shows a significant decrease in total catch: in 2000 11,242 pounds (5.1 mt) and 2001 61,765 pounds (28 mt).

Total catch in numbers increased nearly five-fold from 1982-1989 (Table 1). In the North Atlantic states, Maine - Connecticut, catch peaked in 1988 at nearly 400,000 fish and declined to fewer than 250,000 fish in 1993 (Table 17). Recently, the total recreational catch has fluctuated between 160,000 and 130,000 fish. In 2001, there was a significant increase in the North Atlantic to about 650,000 fish. Peak catches of nearly 450,000 fish occurred in the Mid-Atlantic states (New York - Virginia) in 1991. The number caught in 1996 declined to about 50,000. Catches of spiny dogfish from North Carolina to Florida

increased dramatically after 1979, but are an order of magnitude lower than observed in the Mid-Atlantic and New England states. Historically, less than 4% of the spiny dogfish catch comes from North Carolina to Florida. Most dogfish are released after capture. The proportion of the released catch has increased more than 90% in recent years (Table 16). Most of the recreational spiny dogfish catch is taken from party/charter and private/ rental boats (Table 18) in ocean waters greater than three miles from shore (Table 19).

Even if all of the spiny dogfish that is caught and released and is assumed to die after release, recreational catches have constituted only about 8% of the total landings. Therefore, any imprecision in the estimation of recreational landings is inconsequential relative to the commercial landings and discards, especially in recent years.

Table 16. Spiny dogfish recreational catch, landings and discards (numbers), 1981-2001.

YEAR	CATCH (A+B1+B2)	LANDINGS (A+B1)	DISCARDS (B2)
1981	715,683	597,243	118,440
1982	167,902	28,172	139,730
1983	242,803	26,830	215,973
1984	206,099	36,525	169,574
1985	421,412	35,668	385,745
1986	548,216	73,286	474,930
1987	544,844	122,457	422,387
1988	494,480	144,070	350,410
1989	707,273	167,542	539,731
1990	539,494	71,409	468,085
1991	592,227	52,344	539,883
1992	504,721	97,236	407,485
1993	491,963	47,886	444,077
1994	449,218	61,944	387,274
1995	288,496	27,030	261,465
1996	142,015	10,343	131,672
1997	364,030	26,599	337,431
1998	268,264	24,276	243,988
1999	236,679	21,705	214,974
2000	278,302	2,044	276,258
2001	853,812	11,230	842,583

Source: MRFSS.

Table 17. Spiny dogfish recreational catch (number) by region, 1981-2001.

YEAR	NORTH ATLANTIC	MID-ATLANTIC	SOUTH ATLANTIC
1981	77,564	638,119	----
1982	57,322	110,580	----
1983	58,732	184,071	----
1984	105,940	100,159	----
1985	239,651	169,657	12,104
1986	305,614	242,246	356
1987	304,740	238,866	1,238
1988	368,514	125,373	594
1989	261,193	299,969	146,110
1990	79,968	442,243	17,284
1991	121,137	448,591	22,499
1992	228,611	230,215	45,895
1993	246,488	244,493	982
1994	151,856	296,592	771
1995	149,482	137,301	1,712
1996	89,041	51,325	1,649
1997	137,094	224,415	2,520
1998	162,666	95,678	9,920
1999	131,218	89,553	15,907
2000	166,453	109,402	2,447
2001	650,186	198,639	4,988

Source: MRFSS.

Table 18. Spiny dogfish recreational catch (number) by mode, 1981-2001.

YEAR	Man Made	Beach/Bank	Shore	Party / Charter	Private / Rental
1981	11,955	14,503	----	115,318	573,907
1982	----	----	----	140,126	27,776
1983	1,825	6,667	----	171,929	62,382
1984	409	4,611	----	57,833	143,247
1985	13,408	3,451	----	387,255	17,298
1986	----	----	5,615	245,549	297,052
1987	----	----	3,454	367,400	173,990
1988	----	----	1,539	232,669	260,272
1989	709	138,533	9,465	162,761	395,805
1990	3,058	13,856	11,254	358,819	152,507
1991	1,139	15,070	62,715	139,937	373,366
1992	2,459	21,291	11,268	216,864	252,839
1993	511	264	21,826	210,089	259,273
1994	343	428	21,003	124,467	302,977
1995	----	1,591	6,650	147,242	133,013
1996	278	850	9,998	48,299	82,590
1997	----	----	5,324	174,672	184,034
1998	----	868	34,873	97,195	135,328
1999	----	----	5,810	81,796	149,073
2000	----	----	37,456	89,393	151,404
2001	----	----	22,592	117,829	713,388

Source: MRFSS.

Table 19. Spiny dogfish recreational catch (number) by area, 1981-2001.

YEAR	EEZ (>3 miles)	STATE TERRITORIAL (<=3 miles)	INLAND	STATE TOTAL
1981	673,742	24,264	17,677	41,941
1982	96,457	62,427	9,018	71,445
1983	179,610	2,195	34,997	37,192
1984	187,768	7,896	10,435	18,331
1985	398,392	16,607	6,413	23,020
1986	336,658	1,112,669	98,889	1,211,558
1987	276,364	206,544	61,936	268,480
1988	386,593	67,130	40,757	107,887
1989	418,097	183,651	105,525	289,176
1990	403,039	63,044	73,411	136,455
1991	256,437	240,587	95,203	335,790
1992	290,597	126,871	87,253	214,124
1993	232,035	187,960	71,968	259,928
1994	240,145	109,850	99,223	209,073
1995	171,507	64,625	52,363	116,988
1996	60,992	41,774	39,249	81,023
1997	196,010	112,053	55,966	168,019
1998	99,514	92,741	76,009	168,750
1999	111,307	103,873	21,499	125,372
2000	180,772	61,551	35,979	97,530
2001	392,414	338,037	123,361	461,398

Source: MRFSS.

1.3.2.1 Social and Economic Characterization of the Recreational Fishery

This section is updated from federal spiny dogfish FMP (MAFMC and NEFMC 1999).

In the recreational fishing sector, value and impacts are usually conceptualized as expenditures and revenues associated with fishing trips rather than the value of landings. Impacts and value for a particular species are best thought of in terms of expenditures and concomitant revenues derived from trips targeting that species of fish. From 1994 to 2001, the Marine Recreational Fisheries Statistics Survey (MRFSS) indicated that the number of anglers targeting spiny dogfish as their 'primary' species was less than 1% of the total number of intercept surveys conducted annually in New England and Mid-Atlantic states (Tom Sminke, NMFS, personal communication). Although this number is not expanded to represent all anglers making trips during that year, it suggests that there is not a substantial directed recreational fishery for spiny dogfish.

Therefore, most of the catch of spiny dogfish in the recreational fishing sector appears to be incidental in the targeting of other species. Thus the value of spiny dogfish in the recreational fishing sector in terms of angler expenditures and revenues derived from those expenditures in the targeting of this species appears to be fairly low. Based on the low level of interviewed anglers targeting spiny dogfish in recent years, there would likely be very little lessening of demand for marine recreational fishing trips as a result of any future recreational catch restrictions on spiny dogfish.

1.3.3 Foreign Fishing

This section is updated from federal spiny dogfish FMP (MAFMC and NEFMC 1999).

Spiny dogfish were generally avoided by US fishermen and remained lightly exploited during the late 19th and most of the 20th century. However, spiny dogfish have been a popular foodfish in various

European markets and have also been the target of the foreign fishing fleets throughout the world, including the east coast of North America (Soldat 1979). Significant fishing effort directed at spiny dogfish began in 1965 by vessels from the former Soviet Republic (USSR). By 1970, Poland, the former German Democratic Republic, Japan and Canada also entered the fishery. Most of the foreign landings during the 1970's were attributable to vessels from the former USSR and originated from waters that later became regulated under the Fishery Conservation and Management Act (NAFO Areas 5 and 6). Reported foreign landings of spiny dogfish in NAFO Areas 2-6 (Figure 7) increased from about 0.5 million pounds (207 mt) in 1965 to a peak of 54.1 million pounds (24,549 mt) in 1974 (Table 1). Foreign spiny dogfish landings averaged 29.6 million pounds (12,059 mt) for the period 1965-1977.

In 1977, the United States jurisdiction was extended under the Fishery Conservation and Management Act and the foreign spiny dogfish fishery was regulated. United States regulations restricted foreign vessels fishing for squid and other species to certain areas and times (the so-called foreign fishing "windows"), primarily to reduce spatial conflicts with domestic fixed gear fishermen and minimize bycatch of non-target species. The result of these restrictions was an immediate reduction in the foreign landings of spiny dogfish from 37.4 million pounds (16,971 mt) in 1976 to 1.6 million pounds (706 mt) in 1978. Foreign landings from the US EEZ have sharply curtailed since the expansion of the US fishery during the 1970's.

Estimates of the Atlantic coast Canadian landings are from the Department of Fisheries and Oceans (2002). Since 1977, reported Canadian landings of dogfish have ranged from zero to 8.3 million pounds (3,760 mt) in 2001 (Table 1). The 2001 Canadian landings have increased more than eight-fold since 1997. In 2001, the Canadian spiny dogfish landings were almost 8.3 million pounds compared to the US landings of 5.1 million pounds (2,326 mt).

Since the decline of the directed spiny dogfish fishery in the US, Canadian landings have increased significantly. Before 1997, annual Canadian landings of spiny dogfish were less than 1.0 million pounds (500 mt), but landings doubled in 1998, and again in 1999, and continue to increase through 2001. In 2001, 8.3 million pounds (3,760 mt) were landed from Canadian waters. The majority of the landings (87%) were taken from the Scotia-Fundy region of Nova Scotia (Table 20).

Due the expanding Canadian commercial fishery, the Canadian government placed a quota on the 2002 Atlantic coast spiny dogfish fishery (Fisheries and Oceans Canada 2002). In short, the management measures restrict the harvest to 5,512,500 million pounds (2,500 mt) and allocate 1,543,500 pounds (700 mt) to a science-based sampling program. The sampling program will aid in determining appropriate harvest levels in the future, therefore it remains to be seen how Canada will manage the Atlantic coast spiny dogfish fishery during the rebuilding period described under the interstate management plan.

Table 20. Dogfish landings (pounds, live weight) in Atlantic Canada by province and region.

	Nova Scotia			New Brunswick			PEI	Quebec	Newfoundland	Atlantic
Year	S-F	Gulf	Total	S-F	Gulf	Total	Total	Total	Total	Total
1996	123,480	90,405	213,885	11,025	-	11,025	299,880	414,540	11,025	950,355
1997	615,195	246,960	862,155	-	-	-	50,715	70,560	-	983,430
1998	1,792,665	244,755	2,037,420	125,685	6,615	132,300	103,635	103,635	11,025	2,388,015
1999	4,132,170	535,815	4,667,985	35,280	-	35,280	317,520	421,155	-	5,441,940
2000	5,212,620	97,020	5,309,640	213,885	-	213,885	13,230	328,545	-	5,865,300
2001	7,188,300	101,430	7,289,730	482,895	-	482,895	13,230	253,575	251,370	8,290,800

Source: Canadian Department of Fisheries and Oceans

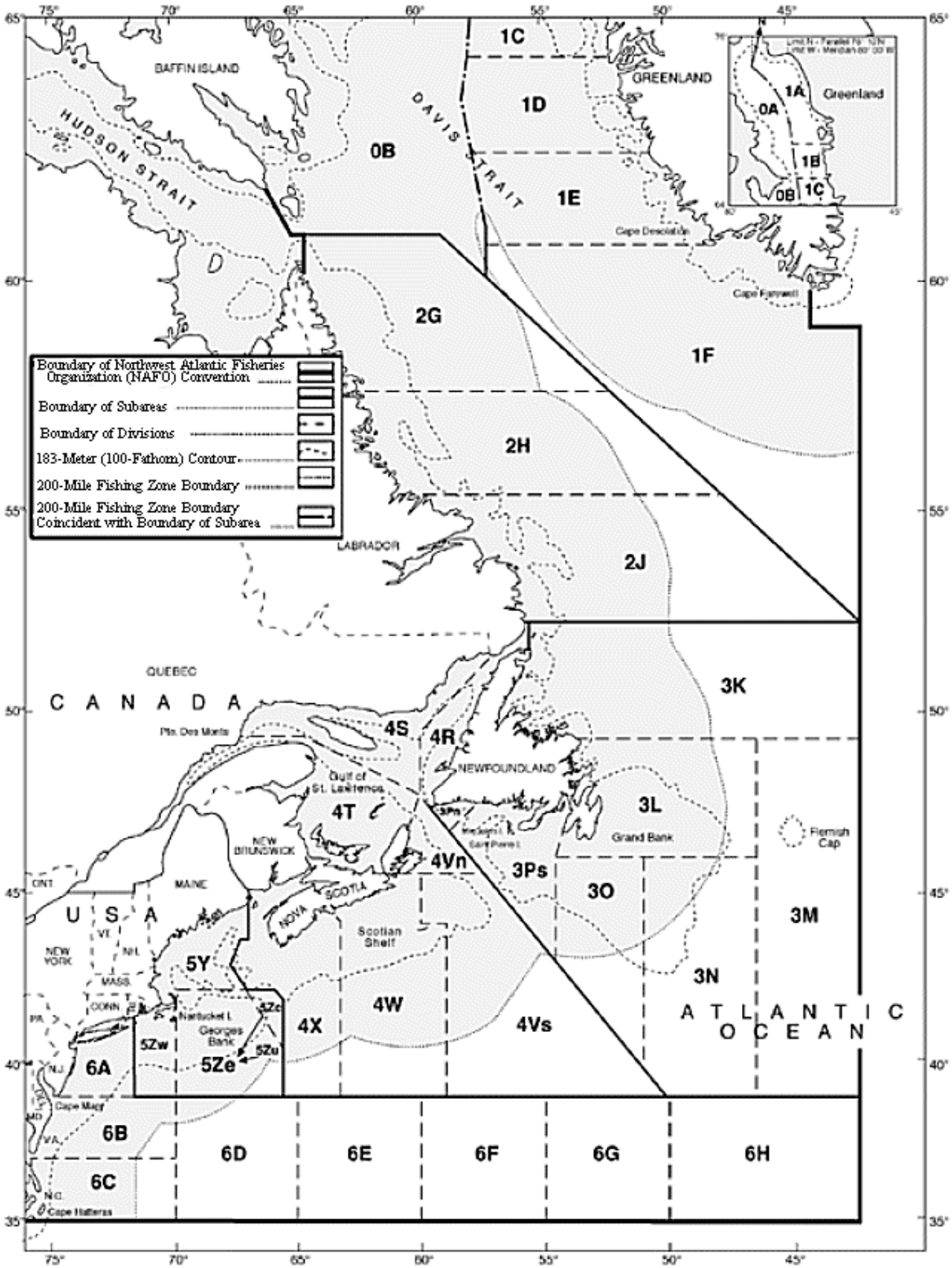

Figure 7. NAFO Statistical Areas Used to Report Commercial Landings in the Northwest Atlantic.

Source: <http://www.nafo.ca/imap/image/map.gif>

1.3.3.1 Foreign Market and Trade

In the early 1990s, New England fishermen were encouraged to harvest spiny dogfish as a means to divert fishing effort away from groundfish. Newly developed export markets were established worldwide. The portion of the fish commonly called the "back" is used in "fish and chips" and is exported to Great Britain, France, Belgium, Italy, and the Netherlands. The market price depends largely on the availability of a competing product from Scotland. Belly flaps are used in Germany and France for a cured product called "schillerlocken". Backs and bellies are commonly sold in two sizes, medium and large. These sizes are further divided into fresh and frozen categories. Fresh fish is airfreighted to awaiting European markets while frozen product is more apt to be sent by ship. In general, the fresh bellies and backs garner higher prices than frozen product. Tails and fins (excluding the dorsal fin, which is not exported and currently has no market) are used in soups and are exported primarily to Pacific Rim nations including China, Taiwan, and Canada. Cartilage and livers are used for medicinal purposes and are exported to Taiwan, Switzerland, Italy, and France. Spiny dogfish skins and body oils are used in the production of "shark skin" products. The head is used in two ways: (1) it is sold as bait for other fisheries or (2) the cartilage is dried and pulverized to service a market for medicinal uses (primarily exported to Pacific Rim nations) (MAFMC 1999).

1.3.4 Interactions with Other Fisheries, Species, or Users

In North Carolina, gill nets are used to target several species, including Atlantic Croaker, weakfish, bluefish and spiny dogfish (Batsavage, 2001). The mesh size and location limits the number of incidentally caught spiny dogfish in these other fisheries. The Atlantic croaker and weakfish fisheries are executed in the same areas as spiny dogfish, but employ a smaller mesh size than the spiny dogfish fishery. Sub-market sized spiny dogfish are often caught in the smaller mesh sizes, but are usually discarded due to the lack of demand.

North Carolina's bluefish ocean gill net fishery uses the same mesh sizes as the spiny dogfish gill net fishery and occasionally encounters large concentrations of spiny dogfish (Batsavage, 2001). The execution of the bluefish fishery prevents even greater incidental catches of spiny dogfish. The bluefish ocean gill nets fish higher in the water column, which means the likelihood of encountering spiny dogfish is less. Also, the gill nets are set directly over schools of bluefish, therefore the soak times are much shorter than other gill net fisheries.

In North Carolina, there is a striped bass fishery that uses gill nets and lasts a few weeks during the winter (Gearhart, 2000). The gill net fishery intercepts the migratory Atlantic striped bass in state waters. When the striped bass quota is reached, directed fishing for striped bass is prohibited. Although the season is closed, striped bass can still be encountered in other gill net fisheries, such as the spiny dogfish sink net fishery. The spiny dogfish sink gill net fisheries made sets in near shore waters, as well as along the edges of shoals, where both spiny dogfish and striped bass are likely to be found in winter months. The instantaneous discard mortality of the striped bass is estimated to be 31%, which is related to mesh and twine size (Gearhart, 2000).

Gearhart (2000) found that North Carolina's ocean sink gill net fisheries are very selective, target species make up more than 90% of the catches. The spiny dogfish gill net fishery in particular was relatively selective for the target species regardless of the fishing method.

1.4 HABITAT CONSIDERATIONS

1.4.1 Description of Important Habitat to the Stock

The following information on dogfish habitat was taken from the federal spiny dogfish FMP MAFMC and NEFMC 1999 as well as "EFH Source Document, Spiny Dogfish, Squalus acanthias: life history and habitat characterization" (McMillan and Morse 1998 and 1999). It does not contain information on eggs and larvae because dogfish are oviviparous (no placenta, live birth). The McMillan and Morse (1998)

document is referred to hereafter as the dogfish EFH background document. The table included in this section are also from this background document.

The descriptions below and in more detail in Table 21 outline spiny dogfish distribution and habitat use from the NEFSC's bottom trawl surveys, the Massachusetts trawl survey, and several key spiny dogfish studies.

1.4.1.1 Juvenile Habitat

Catches of juvenile spiny dogfish and their relationship to bottom water temperatures and bottom depths observed on NEFSC's spring bottom trawl surveys are outlined below. During the spring surveys, observed bottom temperatures ranged from 34-72 ^{o}F (1-22^{o}C). Juvenile spiny dogfish occurred in a bottom temperature range between 37-63 ^{o}F (3-17^{o}C), while most were caught in waters with bottom temperatures between 46-55 ^{o}F (8-13^{o}C). Trawl stations occupied during the spring had a bottom depth range from 16 to 440 ft (5 to 439 m). Juveniles occurred in waters with a bottom depth range between 23 and 1,280 ft (7 and 390 m), while most were caught in waters with bottom depths between 164 and 492 ft (50 and 150 m). The juvenile spiny dogfish caught during the spring surveys were concentrated in offshore waters from North Carolina to the eastern edge of Georges Bank. The highest numbers occurred along the outer shelf (200-660 ft; 60-200m). Juveniles were nearly absent in the northwest portion of the Gulf of Maine.

In the spring Massachusetts bottom trawl surveys, juvenile spiny dogfish were not captured in the Gulf of Maine and were rarely captured in Buzzards Bay and Nantucket Sound. They were more abundant around the southwestern portion of Martha's Vineyard, south of Nantucket Island, along the northeast edge of Cape Cod, and north of Cape Cod Bay. In the spring, juveniles were six times more abundant than adults in trawl catches. Spiny dogfish occurred in waters with bottom temperatures of 2-14ºC; most were caught at temperatures of 7-10ºC. Juvenile occurred at bottom depths ranging from 7-64m; most were caught at depths between 10-44m.

During the autumn NEFSC surveys, observed bottom temperatures ranged from 41-82 ^{o}F (5-28^{o}C). Juvenile spiny dogfish occurred in waters between 41-68 ^{o}F (5-20^{o}C), with the majority caught in waters between 50-59 ^{o}F (10-15^{o}C). Trawl stations occupied during this season had bottom depths ranging from 16 to 1578 ft (5 to 481m). Juvenile spiny dogfish occurred in waters with bottom temperatures ranging from 39 to 1201 ft (2 to 366m), while most were caught in waters with bottom depths between 82 and 246 ft (25 and 75 m). The autumn distribution and relative abundance for juvenile spiny dogfish indicated the highest numbers were evident: 1) around Nantucket Shoals; 2) on Georges Bank and; 3) in waters between Lurcher Shoal and German Bank off the coast of Nova Scotia. It should be noted that juveniles were widespread throughout the Gulf of Maine.

During the autumn Massachusetts bottom trawl survey, juveniles occurred at bottom temperatures ranging from 4-20ºC with peaks at 8-10ºC and 13-16ºC. Juvenile dogfish occurred between 8-82 m; most were caught at depths between 15-34 m.

The winter distribution of juvenile spiny dogfish was widespread across the shelf from North Carolina to the eastern edge of Georges Bank. Juveniles were absent in the western portions of Georges Bank and nearly absent on Nantucket Shoals. The Gulf of Maine was not adequately sampled to describe juvenile distribution during the winter.

Due to inadequate sampling during the summer surveys (i.e. the number of surveys where sex was determined only encompassed the Gulf of Maine and were limited to 1993-1995) McMillan and Morse (1998) could not summarize distribution during this season for juveniles.

1.4.1.2 Adult Habitat

In the spring, the distribution and relative abundance of adults in the NEFSC survey were somewhat similar to that of the juveniles. High numbers of dogfish were seen along the outer shelf from North Carolina to the northeast peak of Georges Bank, continuing onto Browns Bank. Lesser numbers occurred inshore from Cape Hatteras to Long Island, the western portion of Georges, and central Gulf of Maine. During the spring surveys, bottom temperature ranged from 34-72 ^{o}F (1-22^{o}C). Adult spiny dogfish occurred in waters with a bottom temperature range between 37-63^{o} F (3-17^{o}C), while most were caught in waters with bottom temperatures between 45-52 ^{o}F (7-11^{o}C). Trawl stations occupied during the spring had a bottom depth range from 16 to 1440 ft (5 to 439 m). Adults occurred in waters with a bottom depth range between 23 to 1440 ft (7 and 439 m), while most were caught in waters with bottom depths between 164 and 489 ft (50 and 149m).

In the spring Massachusetts bottom trawl surveys, adult spiny dogfish were collected in the southern portions of the survey area and were most abundant on the south shores of Nantucket Island, northeast of Cape Cod, and in Cape Cod Bay. They were caught at bottom temperatures ranging from 1-14ºC; most were caught between 6-12ºC and at depths less than 45m.

During the autumn NEFSC surveys, bottom temperature ranged from 41-82 ^{o}F (5-28^{o}C). Adult spiny dogfish occurred in waters with a bottom temperature range between 41-66 ^{o}F (5-19^{o}C), with the majority being caught in waters with a bottom temperature range between 50 -59 ^{o}F (10-15^{o}C). Trawl stations occupied during this season had bottom depths ranging from 16-1578 ft (5- 481 m). Adults occurred in waters with a bottom depth range between 39-1128 ft (12-344m), while most were caught in waters with bottom depths between 32-161 ft (10-49m). Adults were absent across the shelf from North Carolina to the area just south of the Hudson Canyon. Low numbers occurred along the nearshore area of Long Island. The highest abundance was seen off Nantucket Shoals, then north along the eastern edge of Cape Cod, and into Cape Cod and Massachusetts bays. Another area of high abundance occurred just southwest of Nova Scotia. To a lesser degree than juveniles, adults were scattered throughout the Gulf of Maine and along the northwest edge of Georges Bank.

In the autumn Massachusetts surveys, the highest catches of adults occurred along the eastern shore of Cape Cod near Nauset Beach, near the tip of the Cape, and within Cape Cod Bay. Adult spiny dogfish were caught at bottom water temperatures between 4-20ºC; most were caught at bottom temperatures between 9-15ºC and between 10-34m.

Winter distribution of adult spiny dogfish was very similar to that of winter juveniles. Distribution was widespread across the shelf from Cape Hatteras, North Carolina to the eastern edge of Georges Bank. Adults were nearly absent in the New York Bight, Nantucket Shoals, and completely absent on the western portion of Georges Bank.

Due to inadequate sampling during the summer surveys, i.e. the number of surveys where sex was determined only encompassed the Gulf of Maine and were limited to 1993-1995, McMillan and Morse (1998) could not accurately summarize distribution during this season for adults.

Table 21. Distribution and habitat use for spiny dogfish.

Study	Area	Spatial & Temporal Distribution	Bottom Temp (°C)	Salinity (ppt)	Bottom Depth (m) Bottom Type	Estuarine Use	Prey/Predator
Biglow & Schroeder 1953	Gulf of Maine	Seasonally transient. Cape Cod to Cape Sable. Common on offshore banks as well as along the coast. As early as mid May in Penobscot Bay. Autumnal departure by October-November.	Appear coastally when temperature warms to 6°, and disappear when temp increases to 15°. Preferred range on offshore wintering grounds seems to be 6° to 11°.		Occur at depths anywhere from surface to bottom. Deep water preferred in winter, moving to schoaler water summer-fall.	See spatial column	Prey: Mostly fish, in particular, herrings and mackerel. Practically all species of Gulf of Maine fish smaller than themselves. Squid among regular article found in stomachs. Also known to eat worms, shrimps, and crabs. Upon May arrival in Woods Hole, often found full of Ctenophores.
Jensen, *et al.* 1961, 1965	Northwest Atlantic	Coastal waters from Cape Lookout, NC, northward around Nova Scotia, along both the northern and southern shores of the Gulf of Lawrence, past the Strait of Belle Isle to southeast Labrador. Appear early on Georges Bank (Mar-Apr), New Jersey (Mar). Spring and autumn transients in their southern range, from New York to North Carolina. General migration northward in spring, moving south in fall.	Prefer 7.2° - 12.8° range.		Deep water in winter, shallower water in summer. Average depth at which 100+ dogfish per haul obtained Jan-Jun 1948-1960 = 137 m. Avg. Depth for Jul-Dec same period = 87 m.		Prey: Primarily a fish eater but will also feed on invertebrates, both swimming and bottom-dwelling forms. Clupeoids are important part of diet, but undoubtedly feeds on whatever species are abundant and not too difficult to capture. Predator: Sharks (Mackerel, Great White, Tiger, Blue), Barndoor skate, Lancetfish, Bluefin tuna, Tilefish, Goosefish.
Cohen, 1982	Northwest Atlantic	Labrador to Florida, most abundant from Nova Scotia to Cape Hatteras, NC. As far south as Florida in winter, chiefly north of Cape Cod in summer. Begin southward migration in October, begin returning north in spring.	In Mid-Atlantic and New England areas inhabit waters with bottom temp ranging from 4° to 18°. Preferred temp range seems to be between 7.2° and 12.8°				Prey: Voracious, opportunistic feeders. Most species of fish smaller than themselves, primarily mackerel, herring, scup, flatfish, cod haddock, shrimp, crabs, squid, siphonophores, and sipunculid worms, ctenophores. Predator: Shark (other)
Nammack, *et al.* 1985	Northwest Altantic	Greeland to Southern Florida and Cuba; more typically from Newfoundland to Georgia. Offshore and south in the winter.					
Silva, 1993	Northwest Atlantic	Exhibit extensive seasonal migrations between winter pupping/mating grounds (Cape Hatteras to New Jersey) and summer feeding grounds (Gulf of Maine and Georges Bank to Newfoundland).	7° to 13°.		1968-1990. Juveniles prin. found along 100m contour, adult fem. shallower and inwards from 100m in south, deeper water in north. Adult males sim. to adult females.		
Rago, *et al.* 1994	Northwest Atlantic	Mid-Atlantic waters in winter and spring. Summer movement towards Canadian waters including bays and estuaries. Autumnal migration to the south.	7.2° to 12.8° (Jensen, 1965)			See spatial column	Prey: Herring, Atlantic mackerel, and squid.
Wilk, *et al.* 1997	Hudson-Raritan Estuary, NJ	Nov.-Dec. 1994-1997. Found on Romer Shoals, East Bank, and in Ambrose Channel.	Occurred at: range 7.1° - 11.3°.	Occurred at: range 30.7 - 32.2 ppt	Occurred at: range 12 - 18 m.	See Appendix #1	Prey: Crabs American eel, small fish

Source: McMillan and Morse 1998.

Table 21. (continued) Distribution and habitat use for spiny dogfish.

Study	Area	Spatial & Temporal Distribution	Bottom Temp (°C)	Salinity (ppt)	Bottom Depth (m) Bottom Type	Estuarine Use	Prey/Predator
NMFS, NEFC Juveniles (see Figures 5-8 for season and dates)	Northwest Atlantic	Winter: Across shelf from North Carolina to Georges Bank (GB). Spring: Across shelf from NC to GB, more abundant offshore. Summer: Inadequate sampling. Autumn: Nantucket Is., Georges Bank, between Lucher Shoal and German Bank.	OR=observed range OA=occurred at PR=preferred range Spring OR: 1 - 22 OA: 3 - 17 PR: 8 - 13 Autumn OR: 5 - 28 OA: 5 - 20 PR: 10 - 15		Spring OR: 5 - 439 AR: 7 - 390 PR. 50 - 150 Autumn OR: 5 - 481 AR: 12 - 366 PR: 25 - 75		Major predators on some commercially important species, mainly herring, Atl. Mackerel, and squid, and to a lesser extent, haddock and cod.
NMFS, NEFC Adults (see Figures 13-16 for season and dates)	Northwest Atlantic	Winter: Across shelf from NC to GB. Spring: Outer shelf from MC to northeast peak of GB, Browns Bank. Summer: Inadequate sampling. Autumn: Nantucket Shoals, eastern C. Cop, Cape Cod & Mass. Bays.	Spring: OR: 1 - 22 OA: 3 - 17 PR: 7 - 11 Autumn: OR: 5 - 28 OA: 5 - 19 PR: 10 - 15		Spring: OR: 5 - 439 AR: 7 - 439 PR: 50 - 149 Autumn: OR: 5 - 481 AR: 12 - 344 PR: 10 - 49		See Above
Mass. Inshore trawl survey 1980-1996 Juveniles	Inshore from Vineyard Sound to Cape Ann	Spring: SW Martha's V., Southern Nantucket I., NE Cape Cod, No. Cape Cod Bay. Autumn: NE Nantucket I., Cape Cod and C. Cod Bay, Cape Ann	Spring: OR: 1 - 15 OA: 2 - 14 PR: 7 - 10 Autumn: OR: 4 - 23 OA: 4 - 20 PR: 8 - 10* 13 - 16* *Bimodal preference		Spring: OR: 5 - 82 AR: 7 - 64 PR: 10 - 44 Autumn: OR: 4 - 82 AR: 8 - 82 PR: 15 - 34		
Mass. Inshore trawl survey 1980-1996 Adults	Inshore from Vineyard Sound to Cape Ann	Spring: So. Nantucket I., NE Cape Co, C. Cod Bay, Absent in GOM. Autumn: Eastern C. Cod, No. C. Cod, C. Cod Bay, Cape Ann, Ipswich Bay, Plum I.	Spring: OR: 1 - 15 AR: 1 - 14 PR: 6 - 12 Autumn: OR: 4 - 23 AR: 4 - 20 PR: 9 - 15		Spring: OR: 4 - 82 AR: 6 - 64 PR: < 45 Autumn: OR: 4 - 82 AR: 6 - 82 PR: 10 - 34		
Gottschall, *et al.* In review. Connecticut Bur. Maine Resources Apr-Jun 1984-1994 Jul-Aug 1984-1990	Long Island Sound	Enter the Sound in May and June and depart by early August. Return in September-November with highest numbers in November.			May-June: Prefer waters > 27m, and sand to transitional bottom type September-November: Prefer waters > 27m, and mud to transitional bottom.		

Source: McMillan and Morse 1998.

Table 21. (continued) Distribution and habitat use for spiny dogfish.

Study	Area	Spatial & Temporal Distribution	Bottom Temp (°C)	Salinity (ppt)	Bottom Depth (m) Bottom Type	Estuarine Use	Prey/Predator
Scott, 1982 (two publications)	Scotian Shelf & Bay of Fundy	Summer intruder to Bay of Fundy and Fundian channel. Occas large catches on the Scotian Shelf. Always associated with warm water.	Temp range= 3 - 11 Prefer Temp= 7 - 9	Sal range= 31 - 34 Prefer sal= 31 - 34	Depth range= 37 - 363 Prefer ranges= 20 - 29 70 - 79 90 - 99 pref. 1)For Scotian Shelf drift: glacial till 2)Sambro basin sand 3)Emerald basin salt 4)LaHave basin clay 5)Sable Is. sand & gravel		
Schwartz, 1964	Isle of Wight, Assawoman, Sinepauxent, & Chincoteague Bays, Ocean City, MD	April-June: S. Dogfish from 70 to 90 can occur in the harbor and inlet area of Ocean City, MD	Range during summer: Bays: 20 - 38 Inlet: 23 - 24	Sal range= 26 - 32	Inlet= 7 - 10 m Bays= 2 - 3 m Assawoman: western 3/4=mud eastern 1/4=sand	See "Area"	
Sameoto, *et al.*, 1994	Nova Scotia Shelf	Emerald and LaHave basins, more abundant in June than October.	Emerald basin June: 8.3, October: 8.6	Emer. Bas. June: 34.3	Emerald and LaHave > 200	n/a	Prey: Zooplankton, namely *Calanus finmarchicus & Meganyctiphanes norvegica.*
Azarovitz, *et al.*, 1980	Middle Atlantic Bight	Spring: Larger catches offshore, inshore south of Delaware Bay but have not reaches coastal NJ or NY. Autumn: Southern movement from the northern (summer) grounds has begun. Young of the Year (≤ 32 cm) rarely occur inshore. Pupping is an exclusive offshore event.	Inhabit waters 4 - 18 prefer waters 7.2 - 12.8				See Bigelow & Schroeder, 1953
Woodhead, *et al.*, 1976	Frenchman Bay and surrounding waters, ME	Early June: 89% ♀ caught Flanders Bay. Late June/Early July: 95% ♂ caught off Stave Island. Late July/Early Aug.: Males plentiful around Ironbound Island. Late August: Mostly males caught in Bar Harbor.			All sets made in 16 - 32 m on muddy or sandy bottoms.	See spatial	Bait used = aged salted herring
Soldat, 1979	Northwest Atlantic	Migratory, thermally induced. Dense aggreg during winter off Norfolk, VA, Nantucket I, and southern slopes Georges. Diurnal vertical migrations.	Overall range: 4 - 17 prefer: 6 - 14 Winter: 7 - 10 Summer: 8 - 12		Winter: 200 - 300, as well as 40 - 80. Summer: 60 - 150 on Georges		Feeds mainly on fish, with squid being an important prey item also.

Note: 1 mm = 0.04 in
1 cm = 0.39 in
1 m = 39.37 in
1 kg = 2.2046 lbs

Source: McMillan and Morse 1998.

1.4.2 Identification and Distribution of Habitat and Habitat Areas of Particular Concern

Dogfish are predominately epibenthic species, with no known associations to any particular substrate, submerged aquatic vegetation, or any other structural habitat (McMillan and Morse 1998). However, its life history does focus towards the ocean bottom and spiny dogfish may be potentially adversely impacted if this bottom were to be negatively impacted. In addition, spiny dogfish may rely heavily on estuarine areas for habitat as well as a source of some of their prey such as menhaden.

1.4.3 Present Condition of Habitats and Habitat Areas of Particular Concern

Many anthropogenic actions threaten the integrity of dogfish habitat. Coastal development, water withdrawal, nonpoint source pollution, dredging, port development, marinas, wetland loss, and sewage disposal all impact estuarine areas which spiny dogfish may rely on for habitat and as a source for prey. Because its life history does focus towards the ocean bottom, any mobile gear that comes in contact with the bottom may potentially adversely impact habitat that is important to spiny dogfish. Although it is difficult to gauge the specific impact of mobile gear on spiny dogfish habitat, there are potential impacts.

1.5 IMPACTS OF THE FISHERY MANAGEMENT PROGRAM

1.5.1 Biological Impacts

The constant fishing mortality strategy allows the mature female biomass in the spiny dogfish population to rebuild to a level that will maximize average recruitment and allow sustainable harvests. A coordinated management strategy between state and federal waters further ensures the maintenance of a low fishing mortality rate on the large adult portion of the biomass. Recruitment to the spiny dogfish stock is directly related to and dependent upon the number of adult females in the population. The limited reproductive potential of spiny dogfish offers little flexibility in the level of exploitation while rebuilding the population. Consistent strong recruitment will ensure a more sustainable stock for the future. To further ensure the constant fishing morality rate is not exceeded on an annual basis, the management plan implements a payback provision for quota overages. The payback provision will reduce the fishing mortality rate in the subsequent fishing year to compensate for the overage. The constant fishing mortality strategy assumes the fishing mortality rate will be maintained throughout the entire range of the species. To maintain the rebuilding schedule estimated in *Section 2.6.2*, controls on discards and bycatch may need to be implemented in the future.

1.5.2 Social Impacts

1.5.2.1 Commercial Fishery

Portions of the following section are excerpts from MAFMC et. al. 2002.

According to 2000 unpublished NMFS weighout data, most ports now derive a lower percent of landings value from spiny dogfish since the federal FMP's implementation (as compared to the combined value of all other species landed in that port). The port most dependent on spiny dogfish since the implementation of the federal FMP was Rye, NH where spiny dogfish accounted for 38% of the total pounds and 13% of the total value of all fish landed in this port in 2000 (Table 22). In Oyster, VA, spiny dogfish accounted for 34% of the total pounds and 11% of the total value of all fish landed in that port in 2000. In Hatteras, NC, spiny dogfish accounted for 34% of the total pounds and 9% of the total value of all fish landed in this port in 2000. In Chatham, MA, spiny dogfish accounted for 34% of the total pounds and 9% of the total value of all fish landed in this port in 2000. In Chincoteague, VA, spiny dogfish accounted for 22% of the total pounds and 8% of the total value of all fish landed in this port in 2000. And, in Portsmouth, NH, spiny dogfish accounted for 24% of the total pounds and 7% of the total value of all fish landed in this port in 2000.

Clearly, some of these ports were disproportionately affected by regulatory actions imposed under the FMP. The extent to which local communities were affected "materially" is unknown, but it is likely that

some of the local business which support the commercial fishing industry in these areas were adversely impacted by these actions in the short-term.

At the community level, the largest negative impacts will be realized by those communities where dogfish had been a major component of the fisheries in the mid- to late-1990s. Those communities include Wachapreague (VA), Plymouth (MA), Scituate (MA), Chatham (MA), Ocean City (MD), Wanchese (NC), Hatteras (NC), and Marblehead (MA), among others. In Plymouth, for example, recent restrictions on the dogfish and other fisheries have forced most fishermen to focus almost entirely on the lobster fishery (Hall-Arber et al. 2001). Ex-vessel value of spiny dogfish landed in Plymouth in 2000 was less than 10% of peak value in 1996.

Table 22. Spiny dogfish percent of total landings and value, by port (1997). (MAFMC 1999)

Port	% of total $ from dogfish	% of total lbs. From dogfish	1997 Total pounds of dogfish
Wachapreague, VA	76%	91%	236,000
Plymouth, MA	74%	96%	4,872,917
Scituate, MA	21%	74%	2,236,151
Chatham, MA	14%	47%	5,853,769
Ocean City, MD	11%	32%	4,220,467
Hatteras, NC	11%	30%	2,096,504
Marblehead, MA	10%	48%	333,409
Chincoteague, VA	6%	27%	313,315
Norfolk, VA	5%	22%	310,191
Barnegat, NJ	3%	26%	2,137,567
Camp Ellis, ME	3%	16%	26,386
Gloucester, MA	3%	8%	6,225,688
Rye, NH	3%	27%	101,915
Newport News, VA	3%	34%	2,390,814

Source: NMFS Unpublished Weighout Data. Reprinted from MAFMC (1999).

Although it did not rely on spiny dogfish until the fishery began to build up in the early 1990s, Wachapreague is likely to be one of the more adversely affected communities. Ex-vessel value of spiny dogfish declined by 80% from 1999 to 2000. Values for 2001 were not yet available, though they are expected to have declined from 2000 as a result of harvest restrictions. Dr. Peter Fricke (NMFS, personal communication) states:

> "With regard to the dogfish fishery, the packinghouse and its vessels employ some 20 persons. Any changes in the dogfish fishery would directly impact these persons and this business. Alternative employment might be available in an expansion of the services related to the recreational fishery and in charter-boat operations in the long-term, but more likely displaced packing house employees would need to find work in the poultry processing and trucking businesses of Accomack County and the Delmarva Peninsula. For the watermen affected by any changes in the dogfish fishery, the future is less bright. Dogfish make up 65.2 percent, by weight, of the catches landed in Wachapreague, and thus a major portion of the local vessels seasonal round of fishing. The recreational fishery is largely a small-boat and trailer fishery, and future opportunities to enter the seasonal charter fisheries would require a significant upward demand in charter boat

> services. In a worst case scenario of loss of the dogfish fishery due to stock failure or management action, the community would probably lose a significant portion of its community-based winter employment, and would have to rely on seasonal recreational fishery-related employment and businesses."

The National Marine Fisheries Service (DOC 2001) addressed the impacts of the federal FMP during the 2001 fishing year and stated:

> The impact of the final specifications for the 2001 fishing year will be greatest in Massachusetts, North Carolina, Maryland, Maine, and New Jersey, which accounted cumulatively for 90 percent of spiny dogfish landings from 1988 through 1997. The communities of Wachapreague, VA, Plymouth, MA, and Scituate, MA, have benefited from dogfish landings that made up 76 percent, 74 percent, and 21 percent, respectively, of the value of all landed fish, based on 1997 NMFS landings data. Because these communities have recently derived a relatively high percentage of their fishing income from spiny dogfish, they will be most impacted by the commercial quota and possession limits in the final specifications. These impacts were also experienced in the 2000 fishing year. Two of these communities, Plymouth and Scituate, MA, are suburban areas of a large city (Boston) and are substantially engaged in the businesses of the metropolitan area. The other community, Wachapreague, VA, has significant fishing activities, but also attracts retirees and tourism, and is substantially dependent on these two sectors for economic activity. The analysis also concludes that small vessels (25 to 49 ft or 7.6 to 14.9 m) constitute 91 percent of affected vessels (those vessels experiencing a reduction in revenues of greater than 5 percent) under a 4-million lb. (1,814-mt) commercial quota. However, if no action is taken, communities benefiting from dogfish landings would experience greater lost revenues in the long term due to stock collapse as a result of allowing a directed fishery in the short term.

Quota Allocation

From a social perspective, quota allocation is primarily an equitability issue. Fishermen that feel a limited resource has been fairly and equitably distributed to them are more likely to (1) comply with regulations, (2) have a more favorable view of management, and (3) participate in future fishery management processes. A seasonal allocation scheme, as is currently implemented in the 1999 federal FMP, attempts to "preserve the traditional distribution of landings, both geographically and seasonally" (MAFMC 1999).

Conversely, some fishermen perceive that they were encouraged by NMFS in the early 1990s to develop a dogfish fishery, including significant capital investments in harvesting and processing vessels and facilities. In addition to adverse community impacts, closing or restricting the harvest of spiny dogfish could have negative effects on future cooperative fisheries management efforts.

1.5.2.2 Recreational Fishery

This management plan does not implement regulations for the recreational fishery because most of the catch of spiny dogfish in the recreational fishing sector appears to be incidental in the targeting of other species and is relatively insignificant compared to the commercial fishery. Because there aren't any regulations to restrict the recreational harvest of spiny dogfish, the social impact to the recreational fishery is minimal, if there is any impact at all. Based on the low level of interviewed anglers targeting spiny dogfish in recent years, there would likely be hardly any decrease in demand for marine recreational fishing trips as a result of any future recreational catch restrictions on spiny dogfish.

1.5.3 Economic Impacts

1.5.3.1 Commercial Fishery

Once the stock is rebuilt, long-term benefits should be realized through a sustainable spiny dogfish fishery, which can continue to capitalize on existing markets or take advantage of new markets. One caveat to this is that if the US – based export market does cease for the duration of the rebuilding plan, the level of demand for a product that has been unavailable for many years may be adversely affected (MAFMC 1999).

Closing state waters to the commercial harvest, landing and possession of spiny dogfish, either completely or in coordination with federal closures could result in the loss of the dogfish fishery, particularly while federal TAL remain at their current levels. US fisheries may not be able to meet foreign market demands, market prices will fall if demand shifts to other suppliers or products, and fishermen and processors will be forced to shift their efforts to other fisheries.

The public record indicates evidence of changes already happening in the fishery as a result of the federal FMP and the corresponding ASMFC Spiny Dogfish Emergency Action. For example, the record notes that processors survived the 2000 fishing season by importing spiny dogfish from Canada, and that processors are unlikely to do so again. Markets have already been lost to West Coast, Australian, and New Zealand suppliers. In addition, the low quotas and corresponding low possession limits have created a disincentive for New England fishermen to land spiny dogfish in Mid-Atlantic ports. Higher possession limits for non-federally permitted New England fishermen, particularly in Massachusetts and New Hampshire, further contributed to their incentive to land spiny dogfish in New England. As a result, there are no processors left in the Mid-Atlantic. Spiny dogfish landed in these Mid-Atlantic ports must now be shipped to processors in New England. The public record indicates that the quality and price of the product is lower for trucked fish, and that it is not economical to truck relatively small quantities of fish, as would be the case with current federal possession limits.

ASMFC's 2000 and 2001 Emergency Actions effectively closed all state waters to the possession, harvest, and landing of spiny dogfish whenever the federal TAL was reached. For 2000 and 2001 fishing year, the federal TAL was set at 4.0 million lbs. Except where noted, the following discussion of economic impacts uses the 2001 fishing season as the basis for comparison.

<u>Constant Fishing Mortality Strategy</u>

MAFMC *et al*. (2002) states:

The [federal spiny dogfish] FMP acknowledged that the measures necessary to rebuild the stock would virtually end the directed spiny dogfish fishery, which targets large female spiny dogfish. In order to achieve this goal, management measures must be restrictive enough to reduce the amount of spiny dogfish landings and encourage vessel owners to direct their effort on other species and avoid spiny dogfish. The possession limits of 600 pounds and 300 pounds for quota periods 1 and 2, respectively, would effectively eliminate the directed fishery and would have similar impacts on spiny dogfish trips during their respective quota periods, based on an analysis of NMFS landings data. A possession limit of 600 pounds during quota period 1 and a possession limit of 300 pounds during quota period 2 is projected to impact approximately 67% of spiny dogfish trips that were once involved in the directed commercial fishery. These possession limits were developed to ensure that the quota of 4.0 million pounds is not exceeded and that the F = 0.03 target is achieved.

When compared to the landings of 4.6 million pounds in fishing year 2001, the commercial quota of 4 million pounds represents a 13% reduction in potential landings (MAFMC *et al*. 2002). The economic impact of this reduction is not expected to be significant, since for the most part vessels that participated in the directed fishery have already had to adjust to the changes in the spiny dogfish fishery. The analysis of the possession limits projects the number of days that landings will continue to be allowed under

various commercial quota and possession limit alternatives. The analysis indicates that quota period 1 is likely to close September 5th and quota period 2 is likely to remain open for the entire six-month period. This means that even incidentally caught spiny dogfish could not be legally landed between September 6th and November 1st.

The constant fishing mortality strategy establishes the same commercial quota as the fishing year 2001, 4.0 million pounds. In 2001, the quota was exceeded by 600,000 1b, so restricting landings to 4.0 million pounds would reduce harvest by 13%. This reduction affects spiny dogfish processors as well as fishing vessels (MAFMC 2002). Processors have testified that they require high volumes of spiny dogfish to operate profitably.

Employment in the processing sector of the spiny dogfish industry may face the most severe effects of the implementation of the 4 million pound quota, as required under the constant fishing mortality strategy (MAFMC 2002). The federal FMP indicated that due to the low commercial quotas mandated by the plan, and the labor-intensive nature of hand-processing spiny dogfish, employment reductions would most likely be determined by whether or not processors can find alternative species that require hand processing (MAFMC 2002). If this does not occur, it is likely that seasonal or permanent reductions in employment may occur as a result of this action.

Comparative Analysis of the Constant Fishing Mortality and Constant Harvest Strategy

Whitehead (2002) estimated the effect of monthly landings of spiny dogfish on ex-vessel price per pound, using a model to (1) estimate the increase in ex-vessel price from quotas, and (2) estimate the annual impact of the constant fishing mortality and constant harvest strategies on spiny dogfish while incorporating the price impacts. Time series regression models were built for each state (using NMFS monthly landings and ex-vessel value data) to estimate the percentage change in price due to a 1% change in the landings (inverse demand elasticity). As dogfish landings decrease, the price is generally expected to increase, and vice versa. The model results indicated that a 1% decrease in landings will increase the price by 0.012% in North Carolina and 0.065% in Massachusetts. Tables 23 and 24 summarize the estimated impacts of a 4.0 and 8.2 million-pound quotas on the spiny dogfish fishery. The model assumes that the effects of shipping and processing costs on the ex-vessel price per pound are inherent in the NMFS ex-vessel data and that the quota affects each state equally in percentage terms.

Table 23. Annual Impact of Quotas (2000 dollars).

	1994-1998 Average	Current 4 Million Pound Quota			Proposed 8.82 Million Pound Quota			8.82 vs. 4
	Annual Value	Landings	Annual Value	Annual Impact	Landings	Annual Value	Annual Impact	Annual Impact
Maine	$197,985	69,303	$19,900	-$178,086	152,829	$43,599	-$154,386	$23,700
New Hampshire	$347,310	164,912	$38,047	-$309,263	363,649	$83,529	-$263,781	$45,482
Massachusetts	$4,956,229	1,969,704	$461,591	-$4,494,638	4,343,343	$1,010,725	-$3,945,504	$549,134
Rhode Island	$145,669	88,751	$15,273	-$130,396	195,694	$33,677	-$111,992	$18,404
New York	$7,079	103,922	$25,788	$18,709	229,144	$56,617	$49,538	$30,829
New Jersey	$449,615	371,079	$77,277	-$372,338	818,231	$169,985	-$279,630	$92,708
Maryland	$1,046,477	283,717	$62,987	-$983,490	625,625	$138,892	-$907,585	$75,905
Virginia	$196,871	237,567	$38,784	-$158,087	523,842	$85,520	-$111,351	$46,736
North Carolina	$1,460,895	673,672	$114,796	-$1,346,099	1,485,486	$252,793	-$1,208,102	$137,998
Totals	$8,808,130	3,962,628	$854,443	-$7,953,687	8,737,842	$1,875,337	-$6,932,793	$1,020,894

Source: Whitehead 2002

Table 24. Summary of model-estimated annual impacts of the proposed quotas (2000 dollars)

	4.0 million pound quota (vs. 1994-98 averages)	8.82 million pound quota (vs. 1994-98 averages)	8.82 million pound quota vs. 4.0 million pound quota
Largest impacts	-$4,494,638 (MA) -$1,346,099 (NC)	-$3,945,504 (MA) -$ 1,208,102 (NC)	+$549,134 (MA) +$137,998 (NC)
Smallest impact	-$158,087 (VA)	-$111, 351 (VA)	+$18,404 (RI)
Total impact (all states)	**-$7,953,687**	**-$6,932,793**	**+$1,020,894**

Source: Whitehead 2002

Whitehead (2002) used the model's results to forecast the annual impacts of the proposed quotas in the spiny dogfish fishery. The annual impacts are defined as the reduction in ex-vessel value as a result of the reduction in landings. The model correctly estimated an increase in the ex-vessel price per pound as a result of a reduction in landings, though the effect of the change in landings on price is slight. The proposed 4 million-pound and 8.82 million-pound quotas represent a large reduction in landings over the average landings during 1994-1998. However, the range of price increases is only 0.94% in North Carolina to 5.17% in Massachusetts.

Possession Limits

Possession limits in the commercial fishery are closely tied to the size of the total allowable landings (TAL), as they are typically implemented to keep the fishery open for as long as possible while reducing the likelihood of exceeding the TAL. Unless market prices increase in response to decreases in supply, low possession limits reduce net profits and force fishermen to diversify in order to stay profitable. Processors have indicated at public hearings that the 600-pound and 300-pound possession limits are too low to maintain enough supply to meet the demands of export markets. Ultimately, this demand could shift to suppliers on the West Coast, suppliers in other countries, or other products. For example, the export market of spiny dogfish "backs" to Great Britain competes with a similar product from Scotland.

Steinback and Thunberg (2000) develop a model for determining the effectiveness of possession limits with a 2.9 million-pound quota in the spiny dogfish fishery. Using data from the Northeast Vessel Trip Report program (1994-1998), the model is used to show number of trips, regulatory discards, and closure dates during two quota periods (1.68 million pounds May 1 – October 31; 1.22 million pounds November 1 – April 30). With a 300 pound possession limit, the number of trips are reduced by 36% and 30% in quota periods one and two, respectively. With the 300-pound possession limit, the quota would have been filled after 44 and 41 fishing days in periods one and two, respectively. The model estimates that the regulatory discards would result in 7.8 million pounds of mortality.

1.5.3.2 Recreational Fishery

Most of the catch of spiny dogfish in the recreational fishing sector appears to be incidental in the targeting of other species. Thus the value of spiny dogfish in the recreational fishing sector in terms of angler expenditures and revenues derived from those expenditures in the targeting of this species appears to be fairly low (MAFMC 1999). There is a non-monetary value associated with catching one more fish, but that value is not specific to catching spiny dogfish. Based only on the low level of interviewed anglers targeting spiny dogfish in recent years, there would likely be hardly any decrease in demand for marine recreational fishing trips as a result of any future spiny dogfish recreational catch restrictions.

1.5.4 Other Resource Management Efforts

1.5.4.1 Bycatch

Bycatch is the incidental capture of non-target species, which occurs in most fisheries. One of the main concerns of creating management measures in order to rebuild any stock is increasing the discard mortality associated with the incidental capture in non-directed fisheries. The predominant gear types landing spiny dogfish during the peak period of the fishery in the 1990s were gill nets and trawls. Only limited data is available on the rate of bycatch and the mortality estimate from the discards of spiny dogfish is probably inaccurate. The limited available information indicates that discard mortality is higher in gill nets than from trawls (NEFSC 1998). The rebuilding plan described in the federal FMP assumed background discard mortality losses of spiny dogfish would remain constant after management measures were put into place. Further work on discard rates to determine the magnitude of mortality from incidental capture is necessary.

1.6 LOCATION OF TECHNICAL DOCUMENTATION FOR FMP

1.6.1 Review of Resource Life History and Biological Relationships

Information about the life history of spiny dogfish, *Squalus acanthias*, can be found in the following research publications: Bowman *et al*. (1984), Hoenig and Gruber (1990), Holden (1977), Kenney *et al*. (1985), Langton and Bowman (1977) Nammack *et al*. (1985), and Soldat (1979).

1.6.2 Stock Assessment Document

Paul Rago presented the most recent status of stock information was presented to the Spiny Dogfish Technical Committee in May 2002. *Status Review of Spiny Dogfish and Risk Analysis of Alternative Management Scenarios* includes this presentation (Rago and Sosebee 2002). The 2002 stock update included fishery independent information through the 2001 fall survey and fishery dependent information through 2001. The last full stock assessment was reviewed by the Stock Assessment Review Committee in 1998 (NEFSC, 1998). Spiny dogfish will undergo another full stock assessment in 2003, providing new information about the status of this resource.

1.6.3 Social Assessment Document

More information and more in depth descriptions of the fishing communities can be found in New England Fishing Communities (Hall-Arber *et al*. 2001) and Fishing Ports of the Mid-Atlantic (McCay and Cieri 2000). Information regarding the social impacts of the proposed management options comes from the federal FMP (MAFMC and NEFMC 1999), the Councils' 2002-2003 Spiny Dogfish Specifications (MAFMC and NEFMC 2002), and personal communications with Peter Fricke (2002).

1.6.4 Economic Assessment Document

The potential economic impacts of the management alternatives are drawn largely from Steinback and Thunberg (2000) and Whitehead (2002). Additional economic information on the spiny dogfish fishery came from the Councils' 2002-2003 Spiny Dogfish Specifications (MAFMC and NEFMC 2002).

1.6.5 Law Enforcement Assessment Document

ASMFC's Law Enforcement Committee has prepared a document entitled Guidelines for Resource Managers on the Enforceability of Fishery Management Measures (October 2000) which can be used to evaluate the effectiveness of enforcing fishery management measures.

1.6.6 Habitat Background Document

Most of the information used to describe the spiny dogfish habitat can be found in the federal FMP's Essential Fish Habitat Source Document (McMillian and Morse, 1999).

2.0 GOALS AND OBJECTIVES

2.1 HISTORY AND PURPOSE OF THE PLAN

2.1.1 History of Prior Management Actions

On May 20, 1999, the Atlantic States Marine Fisheries Commission approved the development of an interstate fishery management plan for spiny dogfish. The spiny dogfish fishery is jointly managed by the Mid-Atlantic Fishery Management Council and the New England Fishery Management Council in federal waters. The Secretary of Commerce established a quota of four million pounds, a possession limit of 600 pounds from May 1 to October 30, and a possession limit of 300 pounds from November 1 to April 30.

On August 21, 2000, the Spiny Dogfish Management Board approved an emergency action that closes state water to the commercial harvest, landing and possession of spiny dogfish when the federal fishery is closed due to the spiny dogfish fishery landing the total allowable landings. The intent of the Spiny Dogfish Emergency Action was to: 1) prevent the overharvest of spiny dogfish thereby reducing the risk of stock collapse; 2) prevent the unregulated portion of the spiny dogfish fishery in state waters from undermining the intent of the federal Spiny Dogfish Management Plan; and 3) provide time for ASMFC to develop an interstate spiny dogfish FMP which would provide a framework for managing the fishery in state waters.

After the initial 180-day period, the Spiny Dogfish and Coastal Shark Management Board extended the emergency rule for two additional periods of up to one year each. Due to ASMFC's policies regarding emergency actions, the Spiny Dogfish Emergency Action could not be extended beyond January 31st, 2003. Pursuant to the Emergency Action, the Spiny Dogfish and Coastal Shark Management Board approved the development of an Interstate Spiny Dogfish Fishery Management Plan before the expiration of the Emergency Action on January 31st, 2003.

2.1.2 Purpose and Need for Action

Increasingly over the last two decades spiny dogfish have become an important commercial fishery, providing commercial fishing opportunities during a time when the harvest of other species were being seriously curtailed. Over the last ten years, however, tremendous growth in the fishery has exceeded the availability of the resource and resulted in the development and implementation of stringent fishery management measures in federal waters, and subsequently state waters. The life history strategy of spiny dogfish is one of a long-lived and slow growing species as a result spiny dogfish is highly susceptible to overfishing. The purpose for an interstate fishery management plan is to prevent overfishing and rebuild the female portion of the spawning stock biomass of spiny dogfish.

The federal Spiny Dogfish Fishery Management Plan was partially approved in September 1999 and the FMP's final rule was published in January 2000. Prior to the Management Board's emergency rule, there were no coordinated interstate regulations pertaining to the spiny dogfish fishery in state waters, yet all spiny dogfish landings from non-federally permitted fishermen counted towards the four million-pound coastwide quota. Unlike the federally permitted fisherman, there was no possession limit imposed on many of the non-federally permitted fishermen, therefore non-federally permitted fishermen had the opportunity to land more dogfish before the quota was landed. The Management Board initiated the development of an interstate management plan to coordinate the management efforts between states and to develop complementary regulations between state and federal waters.

2.2 GOALS

The goal of the Interstate Fishery Management Plan for Spiny Dogfish is:

> *"To promote stock rebuilding and management of the spiny dogfish fishery in a manner that is biologically, economically, socially, and ecologically sound."*

2.3 OBJECTIVES

In support of this goal, the following objectives are recommended for the Interstate FMP:

1. Reduce fishing mortality and rebuild the female portion of the spawning stock biomass to prevent recruitment failure and support a more sustainable fishery.
2. Coordinate management activities between state, federal and Canadian waters to ensure complementary regulations throughout the species range.
3. Minimize the regulatory discards and bycatch of spiny dogfish within state waters.
4. Allocate the available resource in biologically sustainable manner that is equitable to all the fishers.
5. Obtain biological and fishery related data from state waters to improve the spiny dogfish stock assessment that currently depends upon data from the federal bottom trawl survey.

2.4 SPECIFICATION OF MANAGEMENT UNIT

The management unit for the Spiny Dogfish Management Plan is defined the range of the spiny dogfish resource within the US waters of the Northwest Atlantic Ocean. Spiny dogfish are migratory species and range from Labrador to Florida. They are most abundant from Nova Scotia to Cape Hatteras. Spiny dogfish are considered a unit stock in the Northwest Atlantic Ocean. It is recognized that the spiny dogfish resource, as defined here, is interstate and state-federal in nature, and that effective assessment and management can be enhanced through cooperative efforts with all Atlantic state and federal scientists and fisheries managers.

2.4.1 Management Area

The management area of this management plan shall be the entire coastwide distribution of the resource from the estuaries eastward to the inshore boundary of the EEZ.

2.5 DEFINITION OF OVERFISHING

In fisheries management, a control rule is used to evaluate the need for management action. The control rule is an indicator of stock status and is based on 1) the level of exploitation or the fishing mortality rate (F), and 2) the level of stock biomass. Overfishing is defined as the relative rate of removals from the population and is determined by the fishing mortality on the stock. The level of (female spawning stock) biomass, as the result of the fishing mortality rate, is the basis for determining if a stock has become overfished. A biomass target or threshold determines the desired condition of the stock whereas the target mortality rate determines how fast the population is moving toward achieving the appropriate level of biomass.

Fishing mortality-based reference points are designed to prevent F from reaching a level that could result in a subsequent decline in the population because individuals are being removed at a rate that is too fast for the stock to replace. Spawning stock biomass (SSB)-based reference points are designed to prevent SSB from getting too low and compromising the ability of the stock to replenish itself. Both fishing mortality rate and biomass levels are used simultaneously to characterize the status of the stock (Figure 8).

The intent of this management plan is to establish a control rule to accurately categorize the status of the stock by considering both fishing mortality and spawning stock biomass, simultaneously. This control rule establishes a target and threshold for the mature female portion of the spawning stock biomass and a target fishing mortality rate. The management program developed through this management plan is designed to achieve the target F and spawning stock biomass levels. The spiny dogfish population will be

considered overfished when the mature female portion of the spawning stock biomass level falls below the threshold spawning stock biomass level established in this management plan. Overfishing of the spiny dogfish population will occur at any time when the fishing mortality rate is exceeded.

The fishing mortality rate recommended for this management plan is also used in the federal management plan for spiny dogfish, F_{rep} (MAFMC and NEFMC, 1999). F_{rep} is a fishing mortality rate that allows for the production of one female pup per female that will recruit to the adult stock. In other words, overfishing occurs when the harvest rate exceeds the stock's replacement rate; and as a result recruitment to the population and the fishery declines.

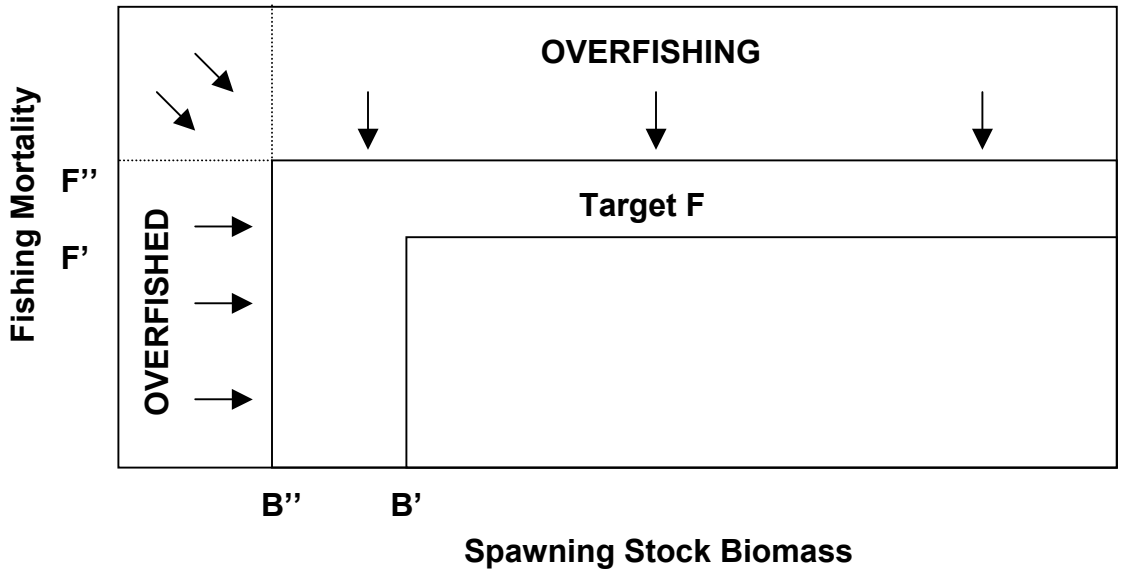

Figure 8. Generalized Representation of the Overfishing Definition utilizing both spawning stock biomass (B', B") and fishing mortality (F', F") targets and thresholds (modified from Mace et al., 1996).

The target and threshold fishing mortality rates are adopted from the federal spiny dogfish management plan (MAFMC and NEFMC, 1999). The threshold fishing mortality rate, $F_{rep} = 0.11$, allows for the production of one female pup per female that will recruit to the spawning stock biomass. The target fishing mortality rate, $F_{rep} = 0.082$, allows for the production 1.5 female pups per female recruit to the spawning stock biomass (Table 25). The threshold and target fishing mortality rates are conditioned on the assumption that the size at entry into the fishery is 27.5 inches (70 cm).

While the female portion of the spawning stock biomass is below the target and threshold SSB, the target fishing mortality rate will be set at 0.03 (Table 25). Setting a low fishing mortality rate allows the stock to rebuild to the level at or near 100% of SSB_{max}. An F of 0.03 is the short term fishing mortality rate applied for duration of the rebuilding period. The stock will be managed under the long term fishing mortality rate of 0.082, once the mature female portion of the spawning stock has reached the target.

The Management Board will evaluate both sets of reference points before proposing changes to or additional management measures in this fishery management plan. In general, if the current F exceeds the threshold level of 0.11, the Board should take steps to reduce the fishing mortality rate to the target level. If F exceeds the short term target (0.03), but is below the threshold, the Board should consider steps to reduce F to the target level. If the current F is below the target F, then no action would be necessary to reduce F.

Table 25. Target Fishing Mortality Rates for Rebuilding and Recovered Stock Conditions and the Threshold Fishing Mortality Rate.

Target Fishing Mortality Rate (rebuilding period)	**0.03**
Target Fishing Mortality Rate (stock ≥ 100% SSB_{max})	**0.082**
Threshold Fishing Mortality Rate	**0.11**

The maximum spawning stock biomass (SSB_{max}) is a proxy for B_{msy} or the level of biomass that would maximize recruitment to the population. For the purposes of this management plan, the spawning stock biomass is the mature female portion of the total population. An overfished stock occurs when the adult female biomass falls below ½ the maximum spawning stock biomass (½ SSB_{max} = 83,500 mt). At the time this management plan was developed, the target female spawning stock biomass was estimated to be 167,000 mt or 100% SSB_{max} (Table 26). This is the level of spawning stock biomass that would maximize the recruitment to the spiny dogfish population.

If SSB falls below its threshold level, the Board would have to take action that would allow the stock to rebuild. If SSB is above the threshold but below the target, the Board should consider taking steps to encourage stock rebuilding. If SSB were above the target, no action would be required. There may be times when one reference point is exceeded, but not the other. In those cases, the Board will consider the relative risk of the situation to stock status before proposing or taking any new action. Future SSB targets and thresholds could change based on a new choice for the fishing mortality target and threshold, i.e. SSB could be higher given the choice of a lower fishing mortality.

2.6 STOCK REBUILDING PROGRAM

The management plan seeks to restore the spiny dogfish stock to the target spawning stock level within the timeframe explained in *Section 2.6.2*. This restoration is expected to result from the application of conservation and management measures contained in *Section 3 and 4*. Modifications may be made as necessary according to the adaptive management procedures contained in *Section 4.5*, if ongoing monitoring indicates that modifications are necessary to meet the FMP goals, objectives and rebuilding targets.

2.6.1 Stock Rebuilding Targets

The stock rebuilding target is defined by the female portion of the spawning stock biomass. The spiny dogfish spawning stock biomass is estimated from the NMFS spring bottom trawl survey and is calculated using survey units (kilograms per tow). Survey units, net dimensions, speed, duration of tow, catchability of the nets, as well as other parameters of the survey are used to estimate the area-swept biomass. Swept-area biomass is commonly used to describe the target and current spiny dogfish biomass (in metric tons) because it provides an easy comparison to the annual quota (in metric tons). The spawning stock biomass target, expressed as area-swept biomass, may change as modifications are made to calculating the area-swept by and catchability of the NMFS spring trawl survey. Recently, modifications were made to calculating the area-swept by the trawl survey. Table 26 shows the area-swept "old scaling" before re-estimating with the necessary parameters to determine the area covered by the trawl survey, as well as the area-swept using the "new scaling". The spawning stock biomass target in survey units (kilograms per tow) was not effected by the changes to the survey footprint or the efficiency

of the trawl survey. The target is to rebuild the female portion of the spawning stock to 100% of the spawning stock biomass (SSB_{max}), which is currently estimated to be 167,000 metric tons (Table 26).

Table 26. Target biomass, minimum biomass thresholds, and current spawning stock biomass expressed in survey units, percentages, area swept (old scaling and new scaling). Numbers apply to the mature female portion of spawning stock biomass.

Female Spawning Stock Biomass (SSB)	Survey Units (kg/ tow)	Percentage of Target Biomass	Area swept "Old scaling"	Area Swept "New scaling"
Target Biomass (SSB_{max})	31.0 kg/tow	100%	200,000 mt	167,000 mt
Minimum Biomass Threshold (1/2 SSB_{max})	15.5 kg/tow	50%	100,000 mt	83,500 mt
Current SSB (mean 2000-2002)	13.5 kg/tow	44%	86,946 mt	72,600 mt

2.6.2 Stock Rebuilding Schedules

Based on the different management strategies considered for this management plan and the life history characteristics of spiny dogfish, the rebuilding time may take as long as 15 to 20 years (Rago 2001). Due to the slow growth and low reproductive capabilities of spiny dogfish, a low fishing mortality rate will produce sustainable harvests in the long run. The rebuilding schedule for spiny dogfish is the time necessary to rebuild the female portion of the spawning stock biomass if an F of 0.03 is maintained throughout the rebuilding period. To estimate the rebuilding time associated with maintaining a fishing mortality rate of 0.03, a risk analysis of the proposed management scenarios was conducted (see *Appendix A1*; Rago and Sosebee 2002). Based on 1999-2001 survey data, there is a 50% probability that the spiny dogfish population will rebuild to the female SSB_{max} (167,000 mt) by 2016 if the constant fishing mortality rate of 0.03 is maintained over this period in both federal and state waters.

2.6.3 Maintenance of Stock Structure

Length and weight trends from both fishery independent and dependent surveys will be monitored by the Technical Committee to assess the stock structure. At 80 cm or 2.1 kg, 50% of the female dogfish are mature and capable of reproducing. Spiny dogfish less than 35 cm are considered pups. Spiny dogfish between the lengths 36 to 79 cm are considered preproductive or immature dogfish that will contribute to recruitment in the near future. The females in these three length classes are strong indicators of the health of the resource and should be monitored by the Technical Committee on an annual basis.

2.7 RESOURCE COMMUNITY ASPECTS

Spiny Dogfish, *Squalus acanthias*, are distributed in the western North Atlantic from Florida to Newfoundland. During spring and autumn, they are found along the coastal waters between North Carolina and Southern New England. Dogfish are principally summer visitors to the Gulf of Maine (including George's Bank) and more northern waters, and in winter are distributed primarily in deeper waters along the edge of the continental shelf. They tend to school by size and, for large mature individuals, by sex. Dogfish are voracious feeders and are known to attack schools of herring and mackerel, as well as concentrations of haddock, cod, sand lance, and other species (NMFS 1991a and 1998a). An analysis of trawls conducted between 1973-1998 in waters from Cape Hatteras, North Carolina to Nova Scotia concluded that elasmobranch (spiny dogfish, smooth dogfish, little skate, winter skate, and thorny skate) predation probably does not have a significant impact on groundfish abundance and finds no relationship between the recruitment success of groundfish and elasmobranch abundance (Link et al 2002).

The ecological role of spiny dogfish is as a widespread, voracious and opportunistic predator. As such, they are also potential competitors with virtually every marine piscivore, including fish, marine mammals and seabirds. Evidence of their competitive potential can be seen in the National Marine Fisheries Service trawl survey data where increases in dogfish and skate abundance, coupled with decreases in abundance of many demersal species, resulted in catches on George's Bank increasing from roughly 25% dogfish and skates by weight in 1963 to almost 75% by the early 1990s (NMFS 1991a and 1998a).

Spiny dogfish, like most sharks, bear relatively large, live young. Unlike most species of bony fishes (Class Osteichthyes), therefore, spiny dogfish do not play a significant role as a forage species, even at a young age.

2.8 IMPLEMENTATION SCHEDULE

The Interstate Fishery Management Plan for Spiny Dogfish was approved and adopted by the Commission on November 21st, 2002. States are required to submit implementation proposals by February 1st, 2003. State proposals will be reviewed for approval during the February 2003 ASMFC meeting week. States are required to implement the provisions of the Interstate Fishery Management for Spiny Dogfish by May 1st, 2003.

3.0 MONITORING PROGRAM SPECIFICATIONS/ELEMENTS

The Spiny Dogfish Technical Committee will meet at least once each year to review the status of the stock assessment and all other relevant data. The Technical Committee will report on all required monitoring elements outlined in *Section 3* and forward any recommendations to the Spiny Dogfish and Coastal Shark Management Board. The Technical Committee shall also report to the Management Board the results of any other monitoring efforts or assessment activities not included in *Section 3* that may be pertinent to the stock status of Spiny Dogfish or indicative of ecosystem health and interactions.

The Spiny Dogfish Advisory Panel will meet at least once each year to review the status of the stock assessment and all other relevant data. The Advisory Panel will forward its report and any recommendations to the Management Board.

The Spiny Dogfish Plan Review Team will annually review implementation of the management plan and any subsequent adjustments (addenda), and report to the Management Board on any compliance issues that may arise. The PRT will also prepare the annual Spiny Dogfish FMP Review and coordinate the annual update and prioritization of research needs (see *Section 6.0*).

The Spiny Dogfish Board encourages all state fishery management agencies to pursue full implementation of the Atlantic Coastal Cooperative Statistics Program (ACCSP), which will meet the monitoring and reporting requirements of this FMP. The Spiny Dogfish Board recommends a transition or phased-in approach be adopted to allow for full implementation of the ACCSP. Until such time as the ACCSP is implemented, the Spiny Dogfish Board encourages state fishery management agencies to initiate implementation of specific ACCSP modules, and/or pursue pilot and evaluation studies to assist in development of reporting programs to meet the ACCSP standards (please refer to the ACCSP Program Design document for specific reporting requirements and standards). The ACCSP partners are the 15 Atlantic coastal states (Maine - Florida), the District of Columbia, the Potomac River Fisheries Commission, the National Marine Fisheries Service, the US Fish and Wildlife Service, the three Regional Fishery Management Councils, and the Atlantic States Marine Fisheries Commission. Participation by program partners in the ACCSP does not relieve states from their responsibilities in collating and submitting harvest/monitoring reports to ASMFC as may be required under this FMP.

3.1 ASSESSMENT OF ANNUAL RECRUITMENT

Recruitment to the spiny dogfish fishery along the Atlantic coast is reviewed on an annual basis in order to set the fishing specifications for the federal fishery management plan. Recruitment will continue to be monitored annually until both the interstate and federal FMP for spiny dogfish change the monitoring program and specification setting process.

Currently the recruitment is approximated via analysis of the Northeast Fisheries Science Center's (NEFSC) spring research vessel survey data. The number of recruits in the spiny dogfish stock are defined as the number of spiny dogfish less than or equal to 35 cm. Because spiny dogfish are long-lived and have low fecundity, there is small interannual variation in recruitment. The annual pup production should be proportional to the number of spawners (NEFSC 1998).

3.2 ASSESSMENT OF SPAWNING STOCK BIOMASS

The status of the Spawning Stock Biomass (SSB) of spiny dogfish along the Atlantic coast is reviewed on an annual basis in order to set the fishing year specifications for the federal fishery management plan. The SSB will continue to be updated annually until both the interstate and federal FMP for spiny dogfish change the specification setting process.

The spawning stock is also monitored via analysis of the NEFSC spring trawl survey data. The number of spawners in the stock is estimated based on the number of female spiny dogfish greater than or equal to 80 cm. 50% of the females reach sexual maturity at 80 cm (NEFSC 1998).

3.3 ASSESSMENT OF FISHING MORTALITY

The fishing mortality rate for spiny dogfish is also review on annual basis as part of the specification setting process for the federal spiny dogfish FMP. The fishing mortality rate will continue to be updated annually until both the interstate and federal FMP for spiny dogfish change the specification setting process.

3.4 SUMMARY OF MONITORING PROGRAMS

3.4.1 Catch and Landings Information

3.4.1.1 Commercial Catch and Effort Data Collection Programs

In order to monitor the fishery and for the states to forecast when a closure will be needed, dealers with permits issued pursuant to state regulations must submit weekly reports showing, at least, the quantity of spiny dogfish purchased (in pounds), the name and permit number of the individuals from whom the spiny dogfish was purchased. Dealers with state permits must report to the state or NMFS all spiny dogfish purchased. States are required to report state landings weekly to NMFS.

The ACCSP commercial data collection program will be a mandatory, trip-based system with all fishermen and dealers required to report a minimum set of standard data elements (refer to the ACCSP Program Design document for details). Submission of commercial fishermen and dealer reports will be required by the 10th of each month.

3.4.1.2 Recreational Catch and Effort Data Collection Programs

The ACCSP recreational data collection program for private/rental and shore modes of fishing will be conducted through a combination telephone and intercept survey. Recreational effort data will be collected through a telephone survey with random sampling of households until such time as a more comprehensive universal sampling protocol is established. Recreational catch data will be collected through an access-site intercept survey. A minimum set of standard data elements will be collected in both the telephone and intercept surveys (refer to the ACCSP Program Design document for details). The

ACCSP will implement research and evaluation studies to expand sampling and improve the estimates of recreational catch and effort.

3.4.2 Discard, Release and Protected Species Interactions Monitoring Program

The ACCSP will require a combination of quantitative and qualitative methods for monitoring discard, release, and protected species interactions in commercial, recreational, and for-hire fisheries. Commercial fisheries will be monitored through an at-sea observer program and several qualitative programs, including strandings, entanglements, trend analysis of logbook reported data, and port sampling. Recreational fisheries will be monitored through add-ons to existing intercept surveys and additional questions added to the telephone survey. For-hire fisheries will be monitored through an at-sea observer program and several qualitative programs (refer to the ACCSP Program Design for details).

3.4.3 Biological Information

Prior to the implementation of the interstate FMP for spiny dogfish, some states were collecting biological information for spiny dogfish from the commercial fisheries (see *Appendix A4* for state monitoring programs). These states should maintain their current monitoring programs and the collection of biological information for spiny dogfish. The collection of biological data should follow the ACCSP guidelines. States without such a program are encouraged to implement a commercial fisheries monitoring program and collect biological information for spiny dogfish.

When fully implemented, the ACCSP will require the collection of baseline biological data on commercial, for-hire, and recreational fisheries. Biological data for commercial fisheries will be collected through port sampling programs and at-sea observers. Biological data for recreational fisheries will be collected in conjunction with the access-intercept survey. Biological data for for-hire fisheries will be collected through existing surveys and at-sea observer programs. A minimum set of standard data elements will be collected in all biological sampling programs (refer to the ACCSP Program Design document for details). Priorities and target sampling levels will be determined by the ACCSP Biological Review Panel, in coordination with the Discard/Release Prioritization Committee.

States collecting fishery independent biological information should maintain their monitoring programs and collect biological information for spiny dogfish (see *Appendix A.4* for state monitoring programs). States without such a program are encouraged to implement a fishery independent monitoring program for the collection of biological information for spiny dogfish, according to the ACCSP guidelines.

3.4.4 Socio-economic Information

3.4.4.1 Commercial Fisheries

No monitoring programs are currently in place for the collection of social and economic information pertaining to persons involved in or affected by the spiny dogfish fishery. The Atlantic Coastal Cooperative Statistics Program (ACCSP) is currently developing standardized, coast-wide protocols for the collection of social and economic fisheries data. This includes fishing communities, and commercial harvesters, processors, and dealers. ACCSP partners should continue to support the development and implementation of these protocols to the extend possible.

3.4.4.2 Recreational Fisheries

When fully implemented, the ACCSP will require the collection of baseline social and economic data on all recreational fisheries through add-ons to existing recreational catch/effort surveys (refer to the ACCSP Program Design document for details). A minimum set of standard data elements will be collected in all for-hire catch/effort surveys (refer to the ACCSP Program Design document for details).

3.4.5 Observer Programs

The ACCSP at-sea observer program is a mandatory program. As a condition of state and/or federal permitting, vessels should be required to carry at-sea observers when requested. A minimum set of standard data elements will be collected through the ACCSP at-sea observer program (refer to the ACCSP Program Design document for details). The Discard/Release Prioritization Committee will determine specific fisheries priorities.

3.5 BYCATCH REDUCTION PROGRAM

State and federal agencies shall make every effort to assess the magnitude of bycatch discard mortality occurring in waters under their jurisdiction. In those cases where bycatch is documented as a serious problem or issue, the involved jurisdiction(s) shall make such documentation available immediately to the Technical Committee, Advisory Panel, and the Management Board. Any documentation shall include, at a minimum, the following information:

1) location, target species, and season of fishery or fisheries involved;

2) gear and gear specifications used in the fishery (e.g., gill nets, mesh size);

3) an estimate of pounds or numbers of spiny dogfish taken per unit of effort in the fishery (e.g., lb. per trip), as well as an estimate of total spiny dogfish bycatch in the fishery;

4) an estimate of how long (e.g., years, months, weeks) spiny dogfish bycatch has occurred as a serious problem in the fishery.

Where appropriate, the National Marine Fisheries Service (NMFS) and/or the US Fish and Wildlife Service (USFWS) shall assist states with preparing the report. The Technical Committee and Advisory Panel shall review such information, and prepare reports for the Management Board. After reviewing these reports, the Management Board may recommend remedial steps to be taken by the involved jurisdictions (e.g., gear restrictions, seasonal/geographic closures, etc.), and may ask the jurisdiction to continue documenting the problem until it is resolved to the Management Board's satisfaction.

In general, states shall undertake every effort to reduce or eliminate the loss of spiny dogfish from the general population due to bycatch discard mortality. The Technical Committee shall examine trends in estimated bycatch annually.

3.6 TAGGING STUDIES/PROGRAM

Tagging of fish and shellfish with individually-numbered tags is a proven technique for determining movement and migration routes and rates, growth rates and patterns, estimation of mortality/survival, estimation of population size (if assumptions are met), stock identification and determination of movement/migration corridors and habitat use. The use of more sophisticated electronic tags can provide additional habitat information such as temperature (of both water and fish body), depth and specific location. The species' Advisory Panel, Stock Assessment Subcommittee, Technical Committee and/or Management Board (for ASMFC), Advisory Panel or Committee (for Fishery Management Councils) and working groups for International Fisheries Commissions may decide to recommend that tagging studies be performed. Alternatively, such studies may be initiated independently by one or more of the partners in the fishery management process.

Fish and shellfish tagging is a technical activity which is usually conducted by scientific personnel; however a number of other entities have become involved in or conducted their own tagging studies. Should a tagging study be proposed for spiny dogfish, a number of considerations should be addressed. Any proposed study must have stated objectives that directly relate to scientific or management purposes.

A second important consideration is whether a species can be tagged with minimal mortality, as the utility of study data will be highly questionable if handling/tagging mortality is high. Should a species prove tag-able, an appropriate tag should be selected for use. The species technical committee will review tag retention studies and suggest most appropriate tags for this species, if a tagging program is initiated for spiny dogfish. The ideal tag should be one which has a unique alpha-numeric identifier and organization contact information, is easily emplaced, has a high rate of retention, is readily visible to potential recoverers without increasing an animal's susceptibility to predation, and remains permanently legible, or in the case of internally-embedded coded wire (CWT) or passive integrated transponder (PIT) tags, is easily and consistently detectable. The implantation location and type of CWT or PIT tags should be fully coordinated with other investigators tagging the same species. Tag number sequences and colors of externally visible tags should be coordinated with other investigators conducting similar studies, via the Interstate Tagging Committee, to ensure that duplication does not occur, and contact information for recoveries and returns should be clearly imprinted on the tag. Tagging should be conducted in a consistent manner by personnel who have been properly trained. Consideration should be given to requiring certification of both professional staff and volunteer angler taggers by the sponsoring organization, in order to increase both the efficiency of tagging and the survival of tagged fish or shellfish through minimization of handling/tagging mortality. The ASMFC Interstate Tagging Committee is in the process of developing a certification for tagging programs, for which sponsoring organizations may wish to apply.

Tagging studies should be highly publicized among the fishing public to maximize the rate of return from both commercial and recreational sectors. In most cases, efforts should be undertaken to accurately measure the rate of tag encounter and return reporting. Each study conducted should ideally assess short-term tagging (handling) mortality; short and long-term tag loss; and reporting rates for each fishery sector. Advertised/promised rewards should be provided promptly upon receipt of data. Study managers should insist on complete and accurate return information. Numbers of animals tagged should be sufficiently high to ensure that the desired information will be produced by the study. Careful and appropriate study design (i.e., purpose, location, sample size, duration, recapture procedures, analysis) is vital to ensure success. Prior to study implementation, a repository for any resultant data should be specified, and long-term commitments made by the sponsoring program, and resources made available to analyze and publish the results. Funds should be provided/reserved to process recaptured tagged animals reported after the program has ended. In angler programs, participants with tagging kits should be notified when the program has ended. All incoming tagging data should be added to the existing database until no additional data are received. Failure to respond to reports of recaptured fish will be detrimental to surrounding tagging programs. Tag reporting apathy develops in anglers when they do not receive replies from the tagging entity.

Investigators may wish to consider collaboration with existing tag database managers (e.g., National Marine Fisheries Service, Southeast Fishery Science Center, Miami, FL, 305-361-4248; NMFS Northeast Fishery Science Center, Woods Hole, MA, 02543; or US Fish and Wildlife Service, Fishery Resources Office, Annapolis, MD, 410-263-2604) for data entry and analysis. Studies should not be undertaken without adequate consideration of all of these issues. The Interstate Tagging Committee strongly encourages programs which are implemented with: 1) connection to an agency or scientific entity for study design and data analyses; 2) an established constituent base to promote the program; 3) training for individuals on proper fish handling and tagging techniques; and 4) identified research needs and objectives.

Any public or private entity which is proposing new tagging studies for spiny dogfish should seek guidelines from and provide a proposal to the Interstate Tagging Committee for review and coordination prior to initiation of any study. The proposal should use the ASMFC's Protocols for Tagging Programs as guidance in developing the proposed study. If the proposed study is an integral component of the FMP,

study design should ideally be reviewed and approved by the Stock Assessment Subcommittee and/or Technical Committee as well, during the FMP review process. Tagging studies outside the ASMFC jurisdiction may choose not to participate in the ASMFC review process.

The ASMFC's Interstate Tagging Committee was developed to serve as a technical resource for jurisdictions other than the ASMFC, as well as for private, non-profit tagging groups, who may plan to tag spiny dogfish. Protocols have been developed by the Committee as a source of information, advice and coordination for all Atlantic coast tagging programs. A copy of the protocol is available on the ASMFC web site. Copies of proposals for review and coordination should be provided to the Interstate Tagging Coordinator at the ASMFC.

4.0 MANAGEMENT PROGRAM IMPLEMENTATION

Currently, the Northwest Atlantic spiny dogfish stock is overfished and overfishing is occurring. The goal of this management plan is to reduce fishing mortality and rebuild the spawning stock biomass to prevent recruitment failure and support a more sustainable fishery. To achieve this goal, the management strategy conserves the mature female portion of the spiny dogfish population to increase recruitment. Rebuilding this late maturing species is further complicated by a directed fishery that at one time focused its effort on the large mature females.

This plan's constant fishing mortality strategy controls the rate of fishing mortality in the spiny dogfish fishery and allows the female portion of the spawning stock to rebuild. This strategy creates low landings in the initial stages of rebuilding. Over time, the total allowable landings (TAL) should increase at a rate that corresponds to the size of the female spawning stock. Until the female spawning stock rebuilds to the target SSB, the fishing mortality rate will be held constant at 0.03.

An annual quota will be allocated to the commercial fishery to control fishing mortality. The quota will be based on the projected stock size estimates for that year as derived from the latest stock assessment information. An estimate of stock size coupled with the target fishing mortality rate allows for a calculation of the TAL. The annual commercial quota will be set between zero and the maximum allowed by a fishing mortality rate of 0.03.

4.1 COMMERCIAL FISHERIES MANAGEMENT MEASURES

4.1.1 Fishing Year

The spiny dogfish commercial fishery shall operate on a May 1st – April 30th fishing year. The annual coastwide quota will be specified for each fishing year and will begin on May 1st.

4.1.2 Semi-Annual Quota Allocation

The coastwide quota, as determined by the annual specification process described in *Section 4.1.2.1*, shall be distributed between semi-annual periods. In effort to coordinate the management of spiny dogfish in state and federal waters, the semi-annual periods are May 1st – October 31st and November 1st – April 30th. A percentage of the coastwide annual quota is allocated to each period and will reflect the level of historical commercial landings during the 1990-1997 reference period. This reference period was chosen to complement the allocation of the quota in federal waters and to facilitate the administration of a coastwide quota. The percentages shall be fixed for both periods, with 57.9% of the coastwide annual quota allocated to Period I and 42.1% to Period II (Table 27). For a detailed description of the semi-annual quota allocation refer to *Appendix A.2*.

Table 27. Percentage of Coastwide Commercial Quota Allocated Between the Semi-Annual Periods Based on Historical Landings Between 1990-1997.

Fishing Year	Period I	Period II
May 1- April 30	May 1 - October 30	November 1 - April 30
Percentage of Coastwide Quota	57.9%	42.1%

The coastal states shall work with the NMFS to administer the quotas, coordinate coastwide closures, and enforce state and federal regulations. All commercial landings shall count toward the coastwide quota regardless of where the spiny dogfish were harvested. When the quota in any given period is projected to have been harvested, the commercial landings, harvest and possession of spiny dogfish will be prohibited in state waters for the remainder of the designated period.

4.1.2.1 Annual Process for Setting Fishery Specifications

The Spiny Dogfish Technical 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 (when available) or length-based stock projection models, and target mortality levels. Based on this review, the Technical Committee will recommend to the Spiny Dogfish Management Board commercial and recreational measures designed to assure that the target mortality level for spiny dogfish is not exceeded. Specifically, the Technical Committee must recommend possession limits for both semi-annual periods and an annual quota within the range of zero and the maximum allowed by a constant fishing mortality rate of 0.03. The Spiny Dogfish Technical Committee's recommendations will be forwarded to the Spiny Dogfish and Coastal Shark Management Board for final approval. When possible, the Spiny Dogfish Technical Committee will coordinate the annual review of the best available data and recommendations for the annual coastwide quota and possession limits for both semi-annual periods with the New England and Mid-Atlantic Fishery Management Councils' Spiny Dogfish Monitoring Committee.

The Spiny Dogfish and Coastal Shark Management Board will annually receive a stock status update report from the Spiny Dogfish Technical Committee that shall include recommendations for an annual commercial quota and possession limits. The Board will consider this information and determine the quota and possession limits for the following year. All specifications shall remain in place until changed by the Spiny Dogfish and Coastal Shark Management Board. All states must implement measures contained in the final decision made by the Board.

In summary, the steps from the Technical Committee to final action by the Spiny Dogfish and Coastal Shark Management Board are:

1. The Technical Committee reviews the most recent stock status data and makes annual commercial quota and possession limit recommendations to the Management Board.

2. The Board considers the recommendations of the Technical Committee in determining the annual coastwide quota and possession limits. The Board makes final decisions on the coastwide quota and possession limits and establishes compliance criteria and dates.

4.1.2.2 Payback of Quota Overages

When the quota in any given period or location is projected to be reached, the commercial landing, harvest and possession of spiny dogfish will be prohibited in state waters for the remainder of the

designated period. When the quota allocated to a semi-annual period is exceeded, the amount over the allocation will be deducted from the corresponding period in the subsequent fishing year.

4.1.2.3 Quota Rollovers

No portion of the annual coastwide quota may be rolled over until the stock has rebuilt to the target SSB. The Spiny Dogfish and Coastal Shark Management Board may consider implementing a rollover provision when the spawning stock has rebuilt to the target described in *Section 2.6.1*. When the mature female portion of the spawning stock has reached its target, quota rollovers shall be limited to 5% of the annual coastwide quota. By prohibiting rollovers during the rebuilding period, the plan preserves the intent to maintain the constant fishing mortality from year to year.

4.1.3 General Administrative Provisions

Presently, there are state and federal permits and reporting requirements that may affect the spiny dogfish fishery. A comprehensive reporting and permitting system, the Atlantic States Coastal Cooperative Statistics Program (ACCSP), is in the process of being developed and implemented.

4.13.1 Dealer and Commercial Fishermen Permitting/Licensing Systems

When fully implemented, the ACCSP will require a comprehensive permit/license system for all commercial dealers and fishermen.

4.1.4 Data Collection and Reporting Requirements

In order to monitor the fishery and for the states to forecast when a closure will be needed, dealers with permits issued pursuant to state regulations must submit weekly reports showing at least the quantity of spiny dogfish purchased (in pounds), and the name and permit number of the individuals from whom the spiny dogfish was purchased. Dealers with state permits must report to the state or NMFS all spiny dogfish purchased. States should report state landings weekly to NMFS.

The ASMFC, NMFS, US Fish & Wildlife Service, the New England, Mid-Atlantic, and South Atlantic Fishery Management Councils, and all the Atlantic coastal states are currently developing a coastwide fisheries statistics program (Atlantic Coastal Cooperative Statistics Program). A minimum set of reporting requirements based on trip-level information for fishermen and dealers is being developed and once adopted by each state and agency, will become the minimum standard for data collection on the Atlantic coast. Nothing in the proposed program would prohibit a state or agency from requiring more detailed information on a trip basis if so desired. As the ACCSP provisions are adopted, they will be incorporated into the reporting requirements for the spiny dogfish fishery and will supercede the requirements stated in the previous paragraph.

4.1.4.1 Vessel Registration System

The ACCSP is developing a standard permitting and registration system in conjunction with the Gulf of Mexico Fisheries Information Network (FIN). This system will be adopted by ACCSP upon completion and will include a minimum set of standard data elements.

4.1.4.2 Quota Monitoring

The coastal states shall work with the NMFS to administer quotas, coordinate coastwide closures, and enforce state and federal regulations. All spiny dogfish landed for sale in a state will be applied against the commercial quota regardless of where the spiny dogfish were harvested. Until ACCSP's quota monitoring program is online, the spiny dogfish commercial landings will be monitored through the National Marine Fisheries Service's Dealer Reporting System. In addition to dealer reports, states will report state landings weekly to NMFS. When the quota is projected to be landed, the Commission's Executive Director will notify each state that commercial landing, harvest and possession of spiny dogfish will be prohibited in state waters for the remainder of the designated period.

The ACCSP will require tracking of all commercial quotas through an Interactive Voice Response (IVR) system. A minimum set of standard data elements will be collected through all IVR systems (refer to the ACCSP Program Design document for details). Under the ACCSP quota monitoring program, any ACCSP partner could authorize another partner to act as agents for collection of specific data elements. Any IVR system implemented by an ACCSP partner must collect complete quota management information for all species managed under a quota type system if there is a realistic possibility that the quota or TAL for that species could be taken during an allocation period. Any ACCSP partner monitoring commercial quotas must submit weekly reports to the responsible partner by the most expedient method no later than Thursday noon following the end of the reporting week. Any ACCSP partner monitoring quotas must electronically submit detailed data to the responsible partner as required in this FMP or using the minimum standards required by the ACCSP (refer to the ACCSP Program Design document for details).

4.1.4.3 Bycatch Monitoring

As stated in *Section 3.5*, state and federal agencies shall make every effort to assess the magnitude of bycatch discard mortality occurring in waters under their jurisdiction. In jurisdictions where bycatch has been identified as a serious problem or issue, the jurisdiction will document the problem according to the outline described in *Section 3.5*.

4.1.5 Possession Limits

Possession limits will be set annually though the fishing year specification process described in *Section 4.1.2.1*. Vessels are prohibited from landing more than the specified amount in any one twenty-four hour period or calendar day.

4.1.6 Biomedical Supply

States may issue spiny dogfish exempted fishing permits for the purposes of biomedical supply, such as those purposes described in *Section 1.3.1.3*. Although there is no restriction on the number of spiny dogfish exempted permits issued, each state is restricted to 1,000 spiny dogfish per year. The amount collected under the state-issued exempted fishing permits will be in addition to the annual quota. States must indicate in the initial implementation plan, and subsequently in the annual state compliance report, that exempted permits will be issued for the biomedical harvest of spiny dogfish. Annual state reports must indicate the actual amount (in numbers of fish and pounds) collected under exempted fishing permits in the previous fishing year, as well as any other pertinent information (i.e. sex, when and how the spiny dogfish were collected). For more information on this spiny dogfish demand, please refer to *Section 1.3.1.3 Biomedical Industry/Scientific Research*.

4.1.7 Prohibition of Finning

Finning is defined as the act of taking a spiny dogfish, removing the fins, and returning the remainder of the spiny dogfish to the sea. Finning spiny dogfish will be prohibited in all state waters. Vessels that land spiny dogfish must land fins in proportion to carcasses, with a maximum 5% fin to carcass ratio, by weight. Fins may be removed at sea, but the corresponding carcass must be retained. All fins and carcasses must be landed at the same time and in the same location.

4.2 RECREATIONAL FISHERIES MANAGEMENT MEASURES

No recreational fishery management measures are proposed in this management plan because currently there are no significant spiny dogfish recreational fisheries on the Atlantic Coast, from Maine to Florida.

4.3 ALTERNATIVE STATE MANAGEMENT REGIMES

Once approved by the Spiny Dogfish and Coastal Shark Management Board, states are required to obtain prior approval from the Board of any changes to their management program for which a compliance

requirement is in effect. Other non-compliance measures must be reported to the Board but may be implemented without prior Board approval. A state can request permission to implement an alternative to any mandatory compliance measure only if that state can show to the Board's satisfaction that its alternative proposal will have the same conservation value as the measure contained in this amendment or any addenda prepared under Adaptive Management (*Section 4.5*). States submitting alternative proposals must demonstrate that the proposed action will not contribute to overfishing of the resource. All changes in state plans must be submitted in writing to the Board and to the Commission either as part of the annual FMP Review process or the Annual Compliance Reports.

4.3.1 General Procedures

A state may submit a proposal for a change to its regulatory program or any mandatory compliance measure under this amendment to the Commission, including a proposal for *de minimis* status. Such changes shall be submitted to the Chair of the Plan Review Team, who shall distribute the proposal to the Management Board, the Plan Review Team, the Technical Committee, the Stock Assessment Subcommittee and the Advisory Panel.

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 as soon as possible to the Management Board for decision.

The Spiny Dogfish and Coastal Shark 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 applicable", and the goals and objectives of this amendment.

4.3.2 Management Program Equivalency

The Spiny Dogfish Technical Committee, under the direction of the Plan Review Team, will review any alternative state proposals under this section and provide to the Spiny Dogfish and Coastal Shark Management Board its evaluation of the adequacy of such proposals.

4.3.3 *De minimis* Fishery Guidelines

The ASMFC Interstate Fisheries Management Program Charter defines *de minimis* as "a situation in which, under the existing condition 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 a Fishery Management Plan or amendment" (ASMFC 2000).

A state may be granted *de minimis* status if a state's commercial landings of spiny dogfish are less than 1% of the coastwide commercial total. If a state meets this criterion, the state will be exempt from biological monitoring of the commercial spiny dogfish fishery. All states, including those granted *de minimis* status, will continue to report any spiny dogfish commercial or recreational landings within their jurisdiction.

States may petition the Spiny Dogfish and Coastal Shark Management Board at any time for *de minimis* status. Once *de minimis* status is granted, designated states must submit annual reports to the Management Board documenting the continuance of *de minimis* status. States must include *de minimis* requests and compliance with *de minimis* requirements as part of their annual compliance reports.

4.4 ADAPTIVE MANAGEMENT

The Spiny Dogfish and Coastal Shark Management Board may vary the requirements specified in this management plan as a part of adaptive management in order to conserve the spiny dogfish resource. Such changes will be instituted, to be effective on the first fishing day of the following year, but may be put in place at an alternative time when deemed necessary by the Management Board. These changes should be

discussed with the appropriate federal representatives and Councils prior to implementation in order to be complementary to the regulations for the EEZ.

4.4.1 General Procedures

The Plan Review Team will monitor the status of the fishery and the resource and report on that status to the Spiny Dogfish and Coastal Shark Management Board annually, or when directed to do so by the Management Board. The Plan Review Team will consult with the Technical Committee, the Stock Assessment Subcommittee and the Advisory Panel, if any, in making such review and report. The report will contain recommendations concerning proposed adaptive management revisions to the management program.

The Spiny Dogfish and Coastal Shark Management Board will review the report of the Plan Review Team, and may consult further with Technical Committee, the Stock Assessment Subcommittee or the Advisory Panel. The Management Board may direct the PRT to prepare an addendum to make any changes it deems necessary. The addendum shall contain a schedule for the states to implement its provisions.

The Plan Review Team will prepare a draft addendum as directed by the Management Board, and shall distribute it to all states for review and comment. A public hearing will be held in any state that requests one. The Plan Review Team will also request comment from federal agencies and the public at large. After a 30-day review period, the Plan Review Team will summarize the comments and prepare a final version of the addendum for the Management Board.

The Management Board shall review the final version of the addendum prepared by the Plan Review Team, and shall also consider the public comments received and the recommendations of the Technical Committee, the Stock Assessment Subcommittee and the Advisory Panel; and shall then decide whether to adopt or revise and, then, adopt the addendum.

Upon adoption of an addendum implementing adaptive management by the Management Board, states shall prepare plans to carry out the addendum, and submit them to the Management Board for approval according to the schedule contained in the addendum.

4.4.2 Measures Subject to Change

The following measures are subject to change under adaptive management upon approval by the Spiny Dogfish and Coastal Shark Management Board:

(1) Overfishing definition;
(2) Rebuilding targets and schedules;
(3) Management areas;
(4) Fishing year and/or seasons;
(5) Fishing year specification process;
(6) Annual specifications for total allowable landings;
(7) Possession Limits;
(8) Seasonal allocation;
(9) Seasonal allocation proportions;
(10) Biomedical research set asides;
(11) Biological research set asides;
(12) Measures to monitor, control, or reduce bycatch;
(13) Compliance Efficiency;
(14) Observer requirements;
(15) Reporting requirements;

(16) Research or monitoring requirements;
(17) Size Limits;
(18) Area closures;
(19) Catch controls;
(20) Gear limitations;
(21) Effort controls;
(22) State-by-state allocation of the coastwide quota;
(23) Regional allocation of the quota;
(24) Allocation of or proportions designated to the components of the regional quota scheme;
(25) Transferability of quota;
(26) Regulatory measures for the recreational fishery;
(27) Recommendations to the Secretaries for complementary actions in federal jurisdictions; and
(28) Any other management measures currently included in the Spiny Dogfish Management Plan.

4.5 EMERGENCY PROCEDURES

Emergency procedures may be used by the Spiny Dogfish and Coastal Shark Management Board to require any emergency action that is not covered by or is an exception or change to any provision in the Spiny Dogfish Management Plan. Procedures for implementation are addressed in the ASMFC Interstate Fisheries Management Program Charter, Section Six (c)(10) (ASMFC 2000).

4.6 MANAGEMENT INSTITUTIONS

The management institutions for spiny dogfish shall be subject to the provisions of the ISFMP Charter (ASMFC 2000). The following is not intended to replace any or all of the provisions of the ISFMP Charter. All committee roles and responsibilities are included in detail in the ISFMP Charter and are only summarized here.

4.6.1 ASMFC and the ISFMP Policy Board

The ASMFC (Commission) and the ISFMP Policy Board are generally responsible for the oversight and management of the Commission's fisheries management activities. The Commission must approve all fishery management plans, and amendments, including this Spiny Dogfish Management Plan; and must also make all final determinations concerning state compliance or noncompliance. The ISFMP Policy Board reviews any non-compliance recommendations of the various Management Boards and Sections and, if it concurs, forwards them on to the Commission for action.

4.6.2 Spiny Dogfish and Coastal Shark Management Board

The Spiny Dogfish and Coastal Shark Management Board was established under the provisions of ASMFC's ISFMP Charter (Section Four [b]) and is generally responsible for carrying out all activities under this management plan (ASMFC 2000).

The Spiny Dogfish and Coastal Shark Management Board (Board) establishes and oversees the activities of the Plan Development or Plan Review Team, the Technical Committee and the Stock Assessment Subcommittee; and requests the establishment of ASMFC's Spiny Dogfish Advisory Panel. Among other things, the Board makes changes to the management program under adaptive management and approves state programs implementing the amendment and alternative state programs under *Sections 4.5* and *4.6*. The Board reviews the status of state compliance with the FMP or amendment at least annually, and if it determines that a state is out of compliance, reports that determination to the ISFMP Policy Board under the terms of the ISFMP Charter.

4.6.3 Spiny Dogfish Plan Development / Plan Review Team

The Spiny Dogfish Plan Development Team (PDT) and the Spiny Dogfish Plan Review Team (PRT) will be composed of a small group of scientists and/or managers whose responsibility is to provide all of the

technical support necessary to carry out and document the decisions of the Spiny Dogfish and Coastal Shark Management Board. Both are chaired by an ASMFC FMP Coordinator. The Spiny Dogfish PDT/PRT is directly responsible to the Board for providing information and documentation concerning the implementation, review, monitoring and enforcement of the Spiny Dogfish Management Plan. The Spiny Dogfish PDT/PRT shall be comprised of personnel from state and federal agencies who have scientific and management ability and knowledge of spiny dogfish. The PDT will be responsible for preparing all documentation necessary for the development of Spiny Dogfish Management Plan, using the best scientific information available and the most current stock assessment information. The PDT will either disband or assume inactive status upon completion of the Spiny Dogfish Management Plan. Alternatively, the Board may elect to retain PDT members as members of the PRT or appoint new members. The PRT will provide annual advice concerning the implementation, review, monitoring, and enforcement of the Spiny Dogfish Management Plan once the Commission has adopted it.

4.6.4 Spiny Dogfish Technical Committee

The Spiny Dogfish Technical Committee will consist of representatives from state or federal agencies, Regional Fishery Management Councils, Commission, university or other specialized personnel with scientific and technical expertise and knowledge of the spiny dogfish fishery. The Board will appoint the members of the Technical Committee and may authorize additional seats as it sees fit. Its role is to act as a liaison to the individual state and federal agencies, provide information to the management process, and review and develop options concerning the management program. The Technical Committee will provide scientific and technical advice to the Management Board, PDT, and PRT in the development and monitoring of a fishery management plan or amendment.

4.6.5 Spiny Dogfish Stock Assessment Subcommittee

The Spiny Dogfish Stock Assessment Subcommittee shall be appointed by the Technical Committee at the request of the Management Board, and will consist of scientists with expertise in the assessment of the spiny dogfish population. Its role is to assess the spiny dogfish population and provide scientific advice concerning the implications of proposed or potential management alternatives, or to respond to other scientific questions from the Board, Technical Committee, PDT or PRT. The Stock Assessment Subcommittee will report to the Technical Committee.

4.6.6 Spiny Dogfish Advisory Panel

The Spiny Dogfish Advisory Panel was established according to ASMFC's Advisory Committee Charter. Members of the Advisory Panel are citizens who represent a cross-section of commercial and recreational fishing interests and others who are concerned about spiny dogfish conservation and management. The Advisory Panel provides the Board with advice directly concerning ASMFC's spiny dogfish management program.

4.6.7 Federal Agencies

4.6.7.1 Management in the Exclusive Economic Zone (EEZ)

Management of spiny dogfish in the EEZ is currently under the jurisdiction of the New England and Mid-Atlantic Fishery Management Councils in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.). In the absence of a Council Fishery Management Plan, management is the responsibility of the NMFS as mandated by the Atlantic Coastal Fishery Conservation and Management Act (16 U.S.C. 5105 et seq.)

4.6.7.2 Federal Agency Participation in the Management Process

The Atlantic States Marine Fisheries Commission has accorded the United States Fish and Wildlife Service (USFWS) and the NMFS voting status on the ISFMP Policy Board and the Spiny Dogfish and Coastal Shark Board in accordance with ASMFC's ISFMP Charter. NMFS and USFWS are involved with several of the spiny dogfish related committees and teams.

4.6.7.3 Consultation with Fishery Management Councils

In carrying out the provisions of the Spiny Dogfish Management Plan, the states, as members of the Spiny Dogfish and Coastal Shark Management Board, shall closely coordinate with both the New England and Mid-Atlantic Fishery Management Council in order to cooperatively manage the Atlantic coast spiny dogfish population. In accordance with ASMFC's ISFMP Charter, a representative of both the New England and Mid-Atlantic Fishery Management Council shall be invited to participate as a full member of the Spiny Dogfish and Coastal Shark Board.

4.7 RECOMMENDATIONS TO THE SECRETARIES FOR COMPLEMENTARY ACTIONS IN FEDERAL JURISDICTIONS

The Atlantic States Marine Fisheries Commission believes that the spiny dogfish resource covered by this fishery management plan continues to be overfished and in need of conservation. This plan coordinates the management of spiny dogfish across state boundaries. In order to achieve the goals and objectives of this management plan, the management of spiny dogfish in federal waters should complement the interstate management plan for spiny dogfish.

4.8 COOPERATION WITH CANADA

The Plan Review Team, Technical Committee, and Management Board shall regularly communicate with fishery managers in Canadian agencies to help ensure the sustainability of the spiny dogfish resource. Canadian fishery managers and their officials shall be invited to ASMFC discussions on spiny dogfish conservation as needed, especially when discussing transshipment issues and cross-border trade.

5.0 COMPLIANCE

Full implementation of the provisions of this management plan is necessary for the management program to be equitable, efficient and effective. States are expected to implement these measures faithfully under state laws. Although the Atlantic States Marine Fisheries Commission does not have authority to directly compel state implementation of these measures, it will continually monitor the effectiveness of state implementation and determine whether states are in compliance with the provisions of this fishery management plan. This section sets forth the specific elements states must implement in order to be in compliance with this fishery management plan, and the procedures that will govern the evaluation of compliance. Additional details of the procedures are found in the ASMFC Interstate Fisheries Management Program Charter (ASMFC 2000).

5.1 MANDATORY COMPLIANCE ELEMENTS FOR STATES

A state will be determined to be out of compliance with the provisions of this fishery management plan, according to the terms of Section Seven of the ISFMP Charter if:

- its regulatory and management programs to implement *Section 4* have not been approved by the Spiny Dogfish and Coastal Shark Management Board; or
- it fails to meet any schedule required by *Section 5.1.2*, or any addendum prepared under adaptive management (*Section 4.5*); or
- it has failed to implement a change to its program when determined necessary by the Spiny Dogfish and Coastal Shark Management Board; or
- it makes a change to its regulations required under *Section 4* or any addendum prepared under adaptive management (*Section 4.5*), without prior approval of the Spiny Dogfish and Coastal Shark Management Board.

5.1.1 Mandatory Elements of State Programs

To be considered in compliance with this fishery management plan, all state programs must include harvest controls on spiny dogfish fisheries consistent with the requirements of *Sections 4.0, 4.1* and *4.2*; except that a state may propose an alternative management program under *Section 4.6*, which, if approved by the Management Board, may be implemented as an alternative regulatory requirement for compliance.

5.1.1.1 Regulatory Requirements

States shall begin to implement the Interstate Fishery Management Plan for Spiny Dogfish after final approval by the Commission. Each state must submit its required spiny dogfish regulatory program to the Commission through the ASMFC staff for approval by the Spiny Dogfish and Coastal Shark Management Board. During the period from submission and until the Management Board makes a decision on a state's program, a state may not adopt a less protective management program than contained in this management plan or contained in current state law. While implementing the provisions of the Interstate FMP for spiny dogfish and upon notification of a closure in federal waters due to the spiny dogfish fishery harvesting the total allowable landings, states waters will close to the commercial harvest, landing and possession of spiny dogfish.

The following lists the specific compliance criteria that a state/jurisdiction must implement in order to be in compliance with the Interstate Fishery Management Plan for Spiny Dogfish:

1. **When the quota is projected to be harvested, states are required to close state waters to the commercial landing, harvest and possession of spiny dogfish for the duration of the seasonal period. Notification of the state's action shall be sent to Commission staff.**
2. **States are required to report landings weekly to NMFS.**
3. **Dealer permits issued pursuant to state regulations must submit weekly reports showing at least the quantity of spiny dogfish purchased (in pounds), the name, and permit number of the individuals from whom the spiny dogfish were purchased.**
4. **States are required to implement possession limits as determined through the annual specification process.**
5. **States must indicate in the implementation plan that exempted permits will be issued for the biomedical harvest of spiny dogfish. Each state is allowed up to 1,000 fish per year. This amount will be allowed in addition to the annual quota. Annual state reports must indicate the actual amount (in numbers of fish and pounds) collected under exempted fishing permits.**
6. **State regulations will reflect the prohibition of finning as described in *Section 4.1.7.***

Once approved by the Spiny Dogfish and Coastal Shark Management Board, states are required to obtain prior approval from the Board of any changes to their management program for which a compliance requirement is in effect. Other measures must be reported to the Board but may be implemented without prior Board approval. A state can request permission to implement an alternative to any mandatory compliance measure only if that state can show to the Board's satisfaction that its alternative proposal will have the same conservation value as the measure contained in this management plan or any addenda prepared under Adaptive Management (*Section 4.5*). States submitting alternative proposals must demonstrate that the proposed action will not contribute to overfishing of the resource. All changes in state plans must be submitted in writing to the Board and to the Commission either as part of the annual FMP Review process or the Annual Compliance Reports.

5.1.1.2 Monitoring Requirements

The PDT and Technical Committee will work to develop appropriate protocols for designing fishery-independent surveys for spiny dogfish. Such surveys may be implemented under *Section 4.5* (Adaptive Management) through the Commission's addendum process including the opportunity for public comment.

5.1.1.3 Research Requirements

A prioritized list of research needs for spiny dogfish was created during the development of this FMP and can be found in *Section 6.0*. The PDT and Technical Committee will annually re-prioritize the research needs for spiny dogfish as part of the FMP Review Process. Appropriate programs for meeting these needs may be implemented under *Section 4.5* (Adaptive Management) through the Commission's addendum process including the opportunity for public comment.

5.1.1.4 Law Enforcement Reporting Requirements

All state programs must include law enforcement capabilities adequate for successfully implementing a state's spiny dogfish regulations. The adequacy of a state's enforcement activity will be monitored annually by reports of the ASMFC Law Enforcement Committee to the Spiny Dogfish Plan Review Team. The first reporting period will cover the period from May 1st, 2003 through April 30th, 2004.

5.1.2 Compliance Schedule

States must implement the Spiny Dogfish Management Plan according to the following schedule:

February 1st, 2003: States must submit programs to implement the Spiny Dogfish Management Plan for approval by the Spiny Dogfish and Coastal Shark Management Board.

May 1st, 2003: All states must implement the Spiny Dogfish Management Plan with their approved management programs. States may begin implementing management programs prior to this deadline if approved by the Management Board.

Reports on compliance must be submitted to ASMFC by each jurisdiction annually, no later than **July 1st, beginning in 2004.**

5.1.3 Compliance Report Content

Each state must submit an annual report concerning its spiny dogfish fisheries and management program for the previous fishing year. Reports should follow the standard report for compliance reports (see *Appendix A.5*), as was adopted by the ISFMP Policy Board. The report shall cover:

- the previous fishing year's fishery and management program including activity and results of monitoring, regulations that were in effect and harvest, including estimates of non-harvest losses;
- the planned management program for the current fishing year summarizing regulations that will be in effect and monitoring programs that will be performed, highlighting any changes from the previous year; and
- the number of spiny dogfish exempted fishing permits issued in the previous fishing year, the actual amount (in numbers of fish and pounds) collected under each exempted fishing permit, as well as any other pertinent information (i.e. sex, when and how the spiny dogfish were collected). The report should also indicate the number of exempted fishing permits issued for the current fishing year.

5.2 PROCEDURES FOR DETERMINING COMPLIANCE

Detailed procedures regarding compliance determinations are contained in the ISFMP Charter, Section Seven (ASMFC 2000). The following summary is not meant in any way to replace the language found in

the ISFMP Charter.

In brief, all states are responsible for the full and effective implementation and enforcement of fishery management plans in areas subject to their jurisdiction. Written compliance reports as specified in the Plan or Amendment must be submitted annually by each state with a declared interest. Compliance with the Spiny Dogfish Management Plan will be reviewed at least annually. The Spiny Dogfish and Coastal Shark Management Board, ISFMP Policy Board or the Commission, may request the Spiny Dogfish Plan Review Team to conduct a review of plan implementation and compliance at any time.

The Spiny Dogfish and Coastal Shark Management Board will review the written findings of the PRT within 60 days of receipt of a State's compliance report. Should the Management Board recommend to the Policy Board that a state be determined out of compliance, a rationale for the recommended non-compliance finding will be included, addressing specifically the required measures of the Spiny Dogfish Management Plan that the state has not implemented or enforced, a statement of how failure to implement or enforce the required measures jeopardizes spiny dogfish conservation, and the actions a state must take in order to comply with the Spiny Dogfish Management Plan requirements.

The ISFMP Policy Board shall, within thirty days of receiving a recommendation of non-compliance from the Spiny Dogfish and Coastal Shark Management Board, review that recommendation of non-compliance. If it concurs in the recommendation, it shall recommend at that time to the Commission that a state be found out of compliance.

The Commission shall consider any Spiny Dogfish Management Plan non-compliance recommendation from the Policy Board within 30 days. Any state which is the subject of a recommendation for a non-compliance finding is given an opportunity to present written and/or oral testimony concerning whether it should be found out of compliance. If the Commission agrees with the recommendation of the Policy Board, it may determine that a state is not in compliance with the Spiny Dogfish Management Plan, and specify the actions the state must take to come into compliance.

Any state that has been determined to be out of compliance may request that the Commission rescind its non-compliance findings, provided the state has revised its spiny dogfish conservation measures or shown to the Board and/or Commission's satisfaction that actions taken by the state provide for conservation equivalency.

5.3 RECOMMENDATION TO JURISDICTIONS OUTSIDE THE MANAGEMENT UNIT

The Spiny Dogfish and Coastal Shark Board, through the Spiny Dogfish Management Plan, requests that those jurisdictions outside the management unit (Pennsylvania, Washington, DC, and the Potomac River Fisheries Commission) implement complementary regulations to protect the overfished spiny dogfish spawning stock.

5.4 ANALYSIS OF ENFORCEABILITY OF PROPOSED MEASURES

The ASMFC Law Enforcement Committee has reviewed the proposed FMP for Spiny Dogfish. It appears that there was an excellent effort to utilize the Law Enforcement Committee's "Guidelines For Resource Managers" in the development of the various harvest restrictions in the Spiny Dogfish FMP. The plan includes daily possession limits, which are reasonably enforceable from a law enforcement standpoint. The plan also includes a finning prohibition section that requires fins and carcasses to be offloaded at the same place and time. This is critical to the enforcement of the plan. Additionally the plan removes the possibility for landing bycatch during closures in the fishery that can be reasonably monitored by law enforcement personnel.

6.0 MANAGEMENT AND RESEARCH NEEDS

The following list of research needs have been identified in order to enhance the state of knowledge of the spiny dogfish resource, population dynamics, ecology, and the various fisheries for spiny dogfish. This list will be reviewed annually by the technical committee, advisory panel, and the management board and an updated, prioritized list will be included in the Annual Spiny Dogfish FMP Review.

6.1 STOCK ASSESSMENT AND POPULATIONS DYNAMICS

- Conduct a US – Canadian transboundary assessment for spiny dogfish and increase data sharing.
- Expand the location (nearshore surveys) and duration of sea sampling activities to obtain a more reliable estimate of population size and age class structure.
- Conduct a stock assessment of spiny dogfish based upon NMFS trawl surveys in the 1960's and 1970's, prior to large decreases in groundfish abundance, for comparisons to current population status.
- Develop a projection model for spiny dogfish that would forecast the status of the population.
- Conduct additional work on the stock-recruitment relationship and estimate the intrinsic rate of population increase.

6.1.1 Biology/Community Ecology

- Evaluate the potential importance of dogfish predation and competition in the ecosystem and conduct further work on the diet composition.

6.2 RESEARCH AND DATA NEEDS

6.2.1 Biological

- Investigate causes for the apparent recruitment failure
- Determine whether or not there is an identifiable area used for pupping.
- Standardize age determination along the entire East Coast.
- Genetic analysis of spiny dogfish to determine if more than one unit stock exist along the Northwest Atlantic.
- Determine coastwide discard mortality rate for fixed and mobile gear fisheries that catch dogfish as bycatch.
- Increase observer trips to document the level of incidental capture of spiny dogfish during the spawning stock rebuilding period.
- Determine discard mortality rates for fixed and mobile gear fisheries that are used in the directed fisheries for dogfish.
- Additional analyses of sea sampling data since 1994.
- Further analyses of the commercial fishery is also warranted, especially with respect to the effects of gear types, mesh sizes, and market acceptability on the mean size of landed dogfish.

- Increase the biological sampling of dogfish on research trawl surveys and in the commercial fishery.

- Update maturation and fecundity estimates by length class.

- Recover and encode information on the sex composition prior to 1980 from the survey database.

- Review surveys to decide if mid-water trawling surveys should be included with bottom surveys to increase biological sampling of dogfish.

- Continue work on the change-in-ratio estimators for mortality rates and suggest several options for analyses.

- Analyze the effects of environmental conditions on survey catch rates.

6.2.2 Social

- Update on a regular basis the characterization of fishing communities involved in the spiny dogfish fishery, including the processing and harvesting sectors, based upon Hall-Arber et al. (2001) and McCay and Cieri (2000).

6.2.3 Economic

- Characterize the value and demand for spiny dogfish in the biomedical industry on a state by state basis.

- Develop procedures for evaluating alternative opportunities and the mortality impacts that result from this switching to alternative opportunities behavior. Use Multinomial logit and random utility models to provide information on future possession limit analyses and expand upon Steinback and Thunberg's (2002) trip limit analysis. Trip limit cost estimates should be corroborated through industry advisor input or through other sources of data. Sensitivity analyses of Steinback and Thunberg's (2002) analysis should be conducted in the future to determine the range of possible outcomes.

- Characterize the spiny dogfish processing sector.

- Monitor the changes to the foreign export markets for spiny dogfish, and evaluate the potential to recover lost markets or expand existing ones.

6.2.4 Management

- Characterize and quantify bycatch of spiny dogfish in other fisheries.

- Monitor the level of effort and harvest in other fisheries as a result of no directed fishery for spiny dogfish.

- Quantify effort directed on spiny dogfish in waters outside of the U.S.

7.0 PROTECTED SPECIES

In the fall of 1995, Commission member states, the National Marine Fisheries Service (NMFS) and the US Fish and Wildlife Service (USFWS) began discussing ways to improve implementation of the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA) in state waters. Historically, these policies have been only minimally implemented and enforced in state waters (0-3 miles). In

November 1995, the Commission, through its Interstate Fisheries Management Program (ISFMP) Policy Board, approved an amendment of its ISFMP Charter (Section Six (b)(2)) so that protected species and their interactions with ASMFC managed fisheries are addressed in the Commission's fisheries management planning process. Specifically, the Commission's fishery management plans will describe impacts of state fisheries on certain marine mammals and endangered species (collectively termed protected species), and recommend ways to minimize these impacts. The following section outlines: (1) the federal legislation which guides protection of marine mammals and sea turtles, (2) the protected species with potential fishery interactions; (3) the specific type(s) of fishery interaction; (4) population status of the affected protected species; and (5) potential impacts to Atlantic coastal state and interstate fisheries.

7.1 MARINE MAMMAL PROTECTION ACT (MMPA) REQUIREMENTS

Since its passage in 1972, one of the underlying goals of the MMPA has been to reduce the incidental serious injury and mortality of marine mammals permitted in the course of commercial fishing operations to insignificant levels approaching a zero mortality and serious injury rate. Under 1994 Amendments, the Act requires NMFS to develop and implement a take reduction plan to assist in the recovery or prevent the depletion of each strategic stock that interacts with a Category I or II fishery. Specifically, a strategic stock is defined as a stock: (1) for which the level of direct human-caused mortality exceeds the potential biological removal (PBR)[1] level; (2) which is declining and is likely to be listed under the ESA in the foreseeable future; or (3) which is listed as a threatened or endangered species under the ESA or as a depleted species under the MMPA. Category I and II fisheries are those that have frequent or occasional incidental mortality and serious injury of marine mammals, respectively, whereas Category III fisheries have a remote likelihood of incidental mortality and serious injury of marine mammals.

Under 1994 mandates, the MMPA also requires fishermen in Category I and II to register under the Marine Mammal Authorization Program (MMAP), the purpose of which is to provide an exception for commercial fishermen from the general taking prohibitions of the MMPA. All fishermen, regardless of the category of fishery they participate in, must report all incidental injuries and mortalities caused by commercial fishing operations.

Section 101(a)(5)(E) of the MMPA requires the authorization of the incidental taking of individuals from marine mammal stocks listed as threatened or endangered under the ESA in the course of commercial fishing operations if it is determined that (1) incidental mortality and serious injury will have a negligible impact on the affected species or stock; (2) a recovery plan has been developed or is being developed for such species or stock under the ESA; and (3) where required under Section 118 of the MMPA, a monitoring program has been established, vessels engaged in such fisheries are registered in accordance with Section 118 of the MMPA, and a take reduction plan has been developed or is being developed for such species or stock. Currently, there are no permits that authorize takes of threatened or endangered species by any commercial fishery in the Atlantic. Permits are not required for Category III fisheries, however, any serious injury or mortality of a marine mammal must be reported.

7.2 ENDANGERED SPECIES ACT (ESA) REQUIREMENTS

The taking of endangered sea turtles and marine mammals is prohibited under Section 9 of the ESA. In addition, NMFS may issue Section 4(d) protective regulations necessary and advisable to provide for the conservation of threatened species. There are several mechanisms established in the ESA to avoid the takings prohibition in Section 9. First, a 4(d) regulation may include less stringent requirements intended to reduce incidental take and thus allow for the exemption from the taking prohibition. Section

[1] PBR is the number of human-caused deaths per year each stock can withstand and still reach an optimum population level. This is calculated by multiplying "the minimum population estimate" by "½ stock's net productivity rate" by "a recovery factor ranging from 0.1 for endangered species to 1.0 for healthy stocks."

10(a)(1)(B) of the ESA authorizes NMFS to permit, under prescribed terms and conditions, any taking otherwise prohibited by Section 9 of the ESA, if the taking is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Finally, Section 7(a) requires NMFS to consult with each federal agency to ensure that any action that is authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any listed species. Section 7(b) authorizes incidental take of listed species after full consultation and identification of reasonable and prudent alternatives or measure to monitor and minimize such take.

7.3 PROTECTED SPECIES WITH POTENTIAL FISHERY INTERACTIONS

There are numerous species that inhabit the management unit of this FMP that are afforded protection under the MMPA and ESA. Eleven are classified as endangered or threatened under the ESA, while the remainder are protected by the provisions of the MMPA.

In addition, over 50 species of marine birds occur within the areas fished for spiny dogfish. These include fulmars, shearwaters, storm petrels, jaegers, skuas, and various species of terns and gulls. Approximately 20 species of marine birds breed along the northern and central Atlantic coast. Another seven species breed in other parts of the Atlantic Ocean and spend their non-breeding season in northern and Mid-Atlantic waters from May through September. An additional 15 species winter in the Mid-Atlantic region where and when the dogfish fishery may occur. All of these birds are protected under the Migratory Bird Treaty Act.

Listed below are protected species found in coastal Northwest Atlantic waters.

Endangered

Right whale	(*Eubalaena glacialis*)
Humpback whale	(*Megaptera novaeangliae*)
Fin whale	(*Balaenoptera physalus*)
Sperm whale	*(Physeter macrocephalus)*
Blue whale	*(Balaenoptera musculus)*
Sei whale	*(Balaenoptera borealis)*
Green Turtle[2]	*(Chelonia mydas*)
Leatherback turtle	(*Dermochelys coriacea*)
Kemp's ridley	(*Lepidochelys kempii*)
Hawksbill	*(Eretmochelys imbricata)*
Shortnose sturgeon	(*Acipenser brevirostrum*)
Roseate tern	(*Sterna dougallii)*
Bermuda petrel	*(Pterodroma cahow)*

Threatened

Green sea turtle	(*Chelonia mydas*)
Loggerhead turtle	(*Caretta caretta*)

MMPA

Includes all marine mammals above in addition to:

Minke whale	(*Balaenoptera acutorostrata*)
Bottlenose dolphin	(*Tursiops truncatus*)
Harbor porpoise	(*Phocoena phocoena*)
Harbor seal	(*Phoca vitulina*)

[2] The breeding populations of green turtles in Florida and on the Pacific coast of Mexico are listed as endangered, the remainder of the population is listed as threatened.

Grey seal (*Halichoerus grypus*)
Harp seal (*Phoca groenlandica*)

Species of Concern
Red-throated loon (*Gavia stellata)*
Black-capped petrel (*Pterodroma hasitata)*
Common loon (*Gavia immer)*
Razorbill (*Alca torda)*

7.4 PROTECTED SPECIES INTERACTIONS WITH EXISTING FISHERIES

Prior to 1990, the spiny dogfish fishery operated primarily out of Massachusetts. Since then, the fishery has expanded to include every state from Maine to North Carolina. Spiny dogfish fishing effort is concentrated primarily from Maine to New York in the spring and summer and from New Jersey to North Carolina in the fall and winter. Two principal gear types, sink gill nets (and to a lesser degree, drift gill nets) and otter trawls, accounted for the majority of spiny dogfish commercial landings. In 2001, however, there was a surge in dogfish landings taken by longline gear, which accounted for over 57% of the landings for the Atlantic coast.

7.4.1 Marine Mammals

There have been marine mammal interactions in the primary fisheries that target spiny dogfish, including gill net, otter trawl and longlines. Based on the stock status, the species of greatest concern are the right whale, bottlenose dolphin, and harbor porpoise.

The 2001 MMPA List of Fisheries classifies the fisheries by the marine mammal species that have been reported incidentally injured or killed by the gear. Table 28 lists the predominant gears used to target spiny dogfish and the marine mammal interactions associated with those gears.

Subsequent sections discuss the number of documented interactions with the primary species of concern, such as the right whale, bottlenose dolphin, and harbor porpoise. These bycatch reports do not represent a complete list, but rather available records. It should be noted that without an observer program for many of these fisheries, actual numbers of interactions are difficult to obtain.

7.4.1.1 Gill net

Bottlenose Dolphin

From 1996 to 2000, a total of 12 coastal bottlenose dolphin takes were observed in the Mid-Atlantic coastal gill net fishery. This fishery is a combination of small vessel fisheries that target a variety of fish species, including bluefish, croaker, spiny and smooth dogfish, kingfish, Spanish mackerel, spot, striped bass and weakfish (Steve et al. 2001 as cited in Waring et al 2002). It operates in different seasons targeting different species in different states throughout the range of coastal bottlenose dolphins. NMFS has determined that the total estimated average annual fishery-related mortality or serious injury resulting from the 12 observed takes in this fishery is 233 bottlenose dolphins.

When focusing on the spiny dogfish gill net fishery in particular, the North Carolina coastal gill net fishery has had the highest documented level of mortality of coastal bottlenose dolphin, with the North Carolina sink gill net fishery as its largest component in terms of fishing effort and observed takes. From April 1998 through February 2002, there were four observed takes documented in the North Carolina winter gill net fishery. The gear characteristics of these takes included a mesh size range of 5.8” to 6”, twine sizes of .90 mm to 1.05 mm, and string lengths of 1200 to 2100 feet. All takes occurred in water depths of 6 to 9 feet (Palka 2001). Since the implementation of the federal management plan for spiny dogfish in 2000, there have been no observed takes in the spiny dogfish gill net fishery.

North Atlantic Right Whale

Assessing the level of interactions between right whales and fisheries has been difficult to measure and is derived from two primary sources -- observed takes and non-observed fishery entanglement records. There has been only one documented case of an observed take of a right whale and this occurred in a pelagic drift gill net in 1993 (Waring et al. 2002). Subsequent re-examination of this take record, combined with information on additional entanglement reports on this whale, concluded that the suspected mortality of this whale was due to entanglement of lobster pot gear.

All other indications of fishery-related interactions have been derived from entanglement records. Entanglement records maintained by the NMFS Northeast Regional Office (NMFS, unpublished data) from 1970 through 2000, included at least 72 right whale entanglements or possible entanglements, including right whales in weirs, entangled in gill nets, and trailing line and buoys (Waring et al. 2002). From 1996 through 2000, five to nine records of mortality or serious injury (including records from both the US and Canadian waters) involved entanglement or fishery interactions. Unfortunately, most of these records do not contain the detail necessary to assign the entanglements to a particular fishery or location.

Table 28. List of Fisheries: Commercial Fisheries in the Atlantic Ocean (DOC 2002).

Fishery Description	Marine Mammal Species Incidentally Killed/Injured
CATEGORY I	
Northeast sink gillnet	North Atlantic right whale, Humpback whale, Minke whale, Killer whaler, White-sided dolphin, Bottlenose dolphin, Harbor porpoise, Harbor seal, Gray seal, Common dolphin, Fin whale, Spotted dolphin, False killer whale, Harp seal.
Longline	Humpback whale, Minke whale, Risso's dolphin, Long-finned pilot whale, Short-finned pilot whale, Common dolphin, Atlantic spotted dolphin, Pantropical spotted dolphin, Striped dolphin, Bottlenose dolphin, Harbor porpoise.
CATEGORY II	
North Carolina inshore gillnet	Bottlenose dolphin.
Northeast anchored float gillnet	Humpback whale, White-sided dolphin, Harbor seal.
Southeast Atlantic gillnet	Bottlenose dolphin.
U.S. Mid-Atlantic coastal gillnet	Humpback whale, Minke whale, Bottlenose dolphin, Harbor porpoise, Harbor seal, Harp seal, Long-finned pilot whale, Short-finned pilot whale, White sided dolphin, Common dolphin.
CATEGORY III	
Chesapeake Bay inshore gillnet	Harbor porpoise
Delaware Bay inshore gillnet	Humpback whale, Bottlenose dolphin, Harbor porpoise
Long Island Sound inshore gillnet	Humpback whale, Bottlenose dolphin, Harbor porpoise
Rhode Island, southern Massachusetts, & New York Bight inshore gillnet	Humpback whale, Bottlenose dolphin, Harbor porpoise
North Atlantic bottom trawl	Long-finned pilot whale, Short-finned pilot whale, Common whale, White-sided dolphin, Striped dolphin, Bottlenose dolphin.
Gulf of Maine tub trawl groundfish bottom longline/hook-and-line	Harbor seal, Gray seal, Humpback whale

Incidents of entanglements in groundfish gill net gear, cod traps, and herring weirs in waters of Atlantic Canada and the US East Coast were summarized by Read (1994). In six records of right whales becoming entangled in groundfish gill net gear in the Bay of Fundy and the Gulf of Maine between 1975 and 1990, the right whales were either released or escaped on their own, although several whales have been observed carrying net or line fragments (Waring et al. 2002). A right whale mother and calf were released alive from a herring weir in the Bay of Fundy in 1976. For all areas, specific details of right whale entanglement in fishing gear are often lacking. When direct or indirect mortality occurs, some carcasses come ashore and are subsequently examined, or are reported as “floaters” at sea; however, the number of unreported and unexamined carcasses is unknown, but may be significant in the case of floaters. More information is needed about fisheries interactions and where they occur.

On June 14, 2001, in accordance with Section 7 of the ESA, NMFS issued a Biological Opinion pertaining to the authorization of fisheries under the federal Spiny Dogfish Fishery Management Plan.

The opinion concluded that the proposed fisheries are likely to adversely affect the right whale, *Eubalena glacialis*. NMFS based the conclusion on previous patterns of marine mammals and sea turtles that have been captured, injured, or killed through interactions with gear used in the fisheries.

Harbor Porpoise

Before 1998 most of the harbor porpoise takes from US fisheries were from the Northeast sink gill net fishery. In the mid-1980s, using rough estimates of fishing effort, NMFS estimated that a maximum of 600 harbor porpoises was killed annually in this fishery. Between 1990 and 2000, NMFS Sea Sampling Program observed 452 harbor porpoise mortalities related to this fishery, with estimates of annual bycatch ranging from 2,900 animals in 1990 to 270 animals in 1999, and 570 animals in 2000 (Waring et al. 2002).

In July 1993, NMFS initiated an observer program in the Mid-Atlantic coastal gill net fishery. This fishery, which extends from North Carolina to New York, is a combination of small vessel fisheries that target a variety of fish species, some of the vessels operate right off the beach, some use drift nets and others use sink nets. From 1995 to 2000, 114 harbor porpoise were observed taken (Waring et al. 2002). During that time, fishing effort was scattered between New York and North Carolina from the beach to 50 miles from shore. After 1995, documented bycatch was observed from December to May. Annual average estimated harbor porpoise mortality and serious injury from the Mid-Atlantic coastal gill net fishery before implementation of the Harbor Porpoise Take Reduction Plan (1995-1998) was 358 animals. Following implementation of the Take Reduction Plan and other fishery management plans for groundfish in 1998/1999 fishing practices changed, resulting in a decrease in estimated annual average harbor porpoise mortality and serious injury to only 37 animals (1999 and 2000).

7.4.1.2 Otter Trawl

There are no documented interactions (either observed or through entanglement records) between coastal bottlenose dolphins and otter trawl fisheries.

No mortalities or serious injuries of right whales have been documented in the pelagic longline, pelagic pair trawl or other fisheries monitored by NMFS. For a discussion of gear entanglements see Section 7.4.1.1.2.

There was one observed harbor porpoise mortality documented in the North Atlantic bottom trawl fishery from 1989-2000. The take occurred in February 1992 offshore of New Jersey. Since the animal was clearly dead prior to being taken by the trawl, the estimated bycatch for the fishery was zero.

7.4.1.3 Longlines

Entanglement in bottom longline gear is not well documented for any fishery, nor is there any dedicated observer coverage of bottom longline effort.

7.4.2 Sea Turtles

Interactions with sea turtles may occur when fishing effort overlaps with sea turtle distribution. The distribution of dogfish is similar to the migration of turtles, as both are believed to move north in the spring and summer and south in the fall and winter months. This further compounds the potential for interactions. Interactions could occur in the summer and fall, as turtles can be found in northeastern waters from June to November. Juvenile and immature Kemp's ridleys and loggerheads utilize nearshore and inshore waters north of Cape Hatteras during the warmer months and can be found as far north as the waters in and around Cape Cod Bay. Sea turtles are likely to be present off the Virginia, Maryland, and New Jersey coasts by April or May, but do not arrive in great concentrations in New York and northwards until mid-June. Although uncommon north of Cape Hatteras, immature green sea turtles also use northern inshore waters during the summer and may be found as far north as Nantucket Sound.

Leatherback and hawksbill turtles may also occur in the waters where the dogfish fishery operates. With the decline of water temperatures in late fall, sea turtles migrate south to warmer waters. When water temperatures are greater than approximately 11°C, sea turtles may be present in areas where the dogfish fishery occurs.

As mentioned previously, the primary spiny dogfish gear types are sink gill nets, otter trawls, bottom longline, and driftnet gear. The capture of sea turtles could occur in all gear sectors of the fishery, including sink gill nets. Sink gill nets would be most likely to interact with loggerhead, Kemp's ridley, and green sea turtles as these species are commonly found near the bottom. These species, as well as leatherback turtles, may also interact with the driftnet sector. Sea turtles may become entangled in either the buoy lines of the gill nets at the surface or at depth or the nets themselves at depth. Turtles are unlikely to be able to break off fragments of the gear and will probably not be able to stay at the surface while entangled. While turtles are vulnerable to forced submergence, some turtles have been recovered alive from sink gill net gear.

7.4.2.1 Gill nets

The incidental take of sea turtles in sink gill nets for the spiny dogfish fishery are more common in the Mid-Atlantic as compared to the Northeast (NMFS 2001). From May 1994 to September 2000, a total of 5,068 hauls targeting spiny dogfish were observed from Maine to North Carolina, but only six observed takes occurred. A live Kemp's ridley was taken off the coast of North Carolina in November 1998. Five additional turtle takes were observed in North Carolina in 2000. In February 2000, a live loggerhead was taken in 16° C water and in March, a live Kemp's ridley was taken in 13° C water. Also in March of 2000, one dead loggerhead, one live loggerhead, and one dead Kemp's ridley were taken in the same trip and same haul in 15.6° C water. Most of the 2000 takes in North Carolina occurred in gill nets with soak times of 24 hours, but the haul that took three sea turtles had a soak time of 48 hours (NMFS 2001).

Other sea turtle takes have occurred in similar sink gill net fisheries, and while these takes were not by trips targeting spiny dogfish, it does exemplify that sea turtle takes could occur with similar gear and mesh size, and in the same location. In May 1995, a dead loggerhead was taken off Virginia Beach, Virginia, in a 6.5 inch mesh smooth dogfish gill net trip. In November 1995, a live loggerhead was taken off Ocean City, Maryland, in a 6.5-7.0 inch mesh striped bass trip. In 1999 and 2000, seven sea turtles were taken off the coasts of North Carolina and Virginia in sink gill nets of 5.5 to 6.5 inch mesh; mesh comparable in size to that used in the spiny dogfish fishery. The details of these takes are outlined in Table 29.

7.4.2.2 Otter Trawl

Otter trawl effort may also result in the takes of sea turtles. Because otter trawl effort is likely to occur in the lower part of the water column, this gear sector may interact with loggerhead, Kemp's ridley, green, and hawksbill turtles but is unlikely to take leatherback turtles. The capture of turtles in trawls does not always result in mortality; the duration and speed of tows are factors related to the mortality rate.

Incidental takes of sea turtles in otter trawls have been extensively documented (NMFS 2001). Incidental takes of Kemp's ridleys and loggerheads have been reported in summer flounder trawl operations occurring from Virginia to North Carolina and in the shrimp trawl fishery in the southeastern US. In the winter of 1991/1992, a total of 2,711 hours of summer flounder trawl fishing were observed. Eighty-three sea turtles were captured including 50 loggerheads, 29 Kemp's ridleys, two greens, one hawksbill, and one unidentified turtle. Takes were more abundant south of Cape Hatteras and no takes were observed north of Cape Charles, Virginia. Consequently, since 1992, turtle excluder devices (TEDs) have been required in the summer flounder fishery south of Cape Charles. The coastal trawl fishery may also be a substantial source of mortality for sea turtles. From 1994 through 1999, with observer coverage of less than one percent, 34 loggerhead sea turtles were observed taken in the coastal trawl fishery. Nine of these

were recovered dead. Additionally, one loggerhead take was observed in the long-finned squid bottom trawl fishery during the period of 1995 to 1997.

Table 29. Observed Sea Turtle Takes in Mid-Atlantic Sink Gill net Fisheries Other than Spiny Dogfish with Mesh-Size Comparable to that used in the Spiny Dogfish Fishery.

Date	Target Species	Mesh Size	Location	Soak Time (hours)	Water Temperature	Turtle Species	Animal Condition
June 1999	shark unknown	6.0"	Virginia	24	20.5ºC	loggerhead	alive
November 1999	southern flounder	6.5"	North Carolina	24	15ºC	unknown	unknown
May 2000	smooth dogfish	6.0"	Virginia	24	15.5ºC	unknown	alive
October 2000	spanish mackerel	5.0"	North Carolina	1.5	21.1ºC	loggerhead	alive
November 2000 (same trip, different hauls)	king mackerel	5.5"	North Carolina	2.5	19.9ºC	unknown	unknown
		5.5"	North Carolina	2.0	19.9ºC	unknown	unknown
November 2000	king mackerel	5.5"	North Carolina	3.1	17.1ºC	unknown	alive

Little is known about the incidental take of sea turtles in the dogfish otter trawl fishery. From 1989 to approximately 1992, NMFS observers have reported on nearly 8,000 otter trawl hauls from the Gulf of Maine to Long Island (which encompasses a portion of the dogfish fishery areas). The observer effort has been distributed across all months, averaging over 130 hauls per month for four years. No turtles were reported captured on observed trawls within this area. Observer information for otter trawl trips in the northwest Atlantic is also available, but while these takes are thought to have occurred in the Mid-Atlantic, the species targeted by these trips are unknown at this time. In 1994, with 2% observer coverage, 21 live loggerheads were taken in the northwest Atlantic otter trawl fishery. In 1995, with 6% observer coverage, 1 live loggerhead was taken and in 1997, with 1% observer coverage, 1 live loggerhead was taken. There were no takes in 1996 with 16% coverage, in 1998 with 1% coverage, or in 1999 with 3% observer coverage (NMFS 2001).

The best information available is data on observed takes which suggests that fisheries using trawl gear interact with sea turtles and some of these interactions are lethal. However, studies suggest that turtles are not likely to be traveling or foraging along the bottom where lethal trawl takes probably occur. In New York waters, time spent on the surface increased with water depth. In water depths greater than 15 meters, young Kemp's ridleys were found to spend the majority of their time in the upper portions of the water column (Morreale and Standora 1990). In southern New England, loggerheads have been observed incidentally taken in offshore drift gill net and surface longline fisheries, while thousands of hours of observed bottom trawls in similar areas have not yielded any sea turtle takes. This is difficult to quantify however, as bottom trawl trips are uncommon during summer and fall months when sea turtle are most likely to occur in deep Mid-Atlantic and New England waters. Nevertheless, based on the observed takes in other otter trawl fisheries, it is possible that turtles could also be taken in trawls for dogfish.

7.4.2.3 Longline

Entanglement in bottom longline gear is not well documented for any fishery. Of the turtle species, loggerheads would be most likely to interact with this gear sector due to their attraction to baited hooks. Animals may become entangled in the longline or may ingest hooks. However, because longline gear set for dogfish is tended frequently, entanglements may be less likely to occur. Entanglements that do occur may be detected in time to release animals alive.

7.4.3 Seabirds

Some seabirds are vulnerable to entanglement in commercial fishing gear. The magnitude of the interaction has not been well quantified for the spiny dogfish fishery, especially since fishing methods have changed over the past decade. Since the dogfish fishery may occur throughout the year over a wide geographic area and employs a variety of gear types, it is very difficult to assess the amount of bird bycatch that will occur in a spiny dogfish directed fishery.

7.4.3.1 Gill nets

In the Mid-Atlantic region during the winter and spring, the most likely species of birds to be drowned in gill nets from the dogfish fishery are red-throated loons, common loons, red breasted mergansers, and northern gannets. The number of birds caught each year is not well quantified, but most of these birds are capable of diving to 50 to 100 foot depths and occur out to the edge of the continental shelf. In general, the less time the gill net is in the water the less likely the loons will become entangled. The practice of drop netting would seem to be the least likely to catch loons in the Mid-Atlantic region in fall through spring and anchored nets in the early morning and late evening would catch the most diving birds.

In spring through fall in the Northeastern US, some loons, and possibly horned puffins and razorbills, are likely to be caught in gill nets, but far more abundant and likely to be caught are the greater, sooty, Cory's, and Manx shearwaters. The greater followed by the sooty have been documented to be caught in sink gill nets in the highest numbers, but their populations are greater than other shearwaters. Northern gannets are also caught in gill nets in the Northeast. A couple of anecdotal observations have documented that birds are sometimes caught in nets when the nets are being set or retrieved and the birds are attempting to feed on offal or bait in the nets. This type of bycatch might be mitigated by changes in fishing methods.

7.4.3.2 Longlines

In general, birds that forage by scavenging and surface seizing are most likely to be caught on longlines while trying to steal the bait during deployment or retrieval. Within the range of the East Coast dogfish fishery, the species most likely to be caught on longlines are the great black-backed, lesser black-backed, herring, and ring-billed gulls, plus some shearwaters, northern fulmars, northern gannets, and black-capped petrels. The vulnerability of birds to longline gear is dependent on a large variety of factors including the ships size (baited hooks hanging in the air longer from larger ships), gear characteristics (weighted hooks, thawed bait, weighted lines), deterrent devices, the hunger of the birds, and fishing practices such as how and when offal is dumped. A variety of studies throughout the Pacific Ocean in recent years have determined that by using deterrent devices, and modifying gear and methods of fishing can reduce bird bycatch on longlines to very low levels while not reducing the landings.

7.5 POPULATION STATUS REVIEW OF RELEVANT PROTECTED SPECIES

7.5.1 Marine Mammals

Three marine mammal species are known to co-occur with or become entangled in gear used by the Atlantic spiny dogfish fishery, namely, coastal bottlenose dolphin, North Atlantic right whale and harbor porpoise. These three species are classified as strategic stocks under the MMPA. Additionally, the right whale is listed as endangered. Above all, the species of greatest concern is the right whale, which is one of the most endangered species in the world, numbering only around 291 animals (Waring et al. 2002).

The status of these and other marine mammal populations inhabiting the Northwest Atlantic has been discussed in great detail in the US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments. Initial assessments were presented in Baylock et al. (1995) and were updated in Waring et al. (2002). The report presents information on stock definition, geographic range, population size, productivity rates, potential biomass removal (PBR – the number of human-caused deaths the stock can withstand annually and still reach and maintain an optimum population level), fishery specific mortality estimates, and compares the PBR to estimated human-caused mortality for each stock.

7.5.1.1 Bottlenose Dolphin, *Tursiops truncatus*

Under the MMPA, the coastal bottlenose dolphin population is listed as depleted and is classified as a strategic stock. The species ranges on the Atlantic coast from New Jersey south to central Florida (Waring et al. 2002). While there is uncertainty regarding population size and stock structure of Atlantic coastal bottlenose dolphins, the stock is believed to be depleted due to several high mortality events in the past 20 years. There are data suggesting that the population was at an historically high level immediately prior to a 1987-88 mortality event (Keinath and Musick 1988); however, this mortality event was estimated to have decreased the population by as much as 53%.

Within the western North Atlantic, the stock structure of the coastal bottlenose dolphin is complex (Waring et al. 2002). The standing hypothesis has been that there is a single coastal migratory stock, ranging seasonally from as far north as Long Island, New York to as far south as central Florida. More recent studies, however, suggest that this hypothesis is incorrect and that there is likely a complex mosaic of stocks. Evidence to support this hypothesis includes observed geographic distribution, recent genetic analyses, photo-identification studies, satellite telemetry and stable isotope studies. Most of the available data, however, pertain to stocks in the waters off of North Carolina. Fewer data are available for bottlenose dolphins south of North Carolina and the theory of stock separation in this area is tentative. Stock affiliation for coastal animals in inland waters (estuaries, bays, sounds) also is poorly understood.

As a result of these findings and for the purposes of developing the Bottlenose Dolphin Take Reduction Plan, NMFS subdivided the coastal population into eight different management units, partitioned by region and season. These management units are: (1) Northern migratory summer (NJ/NY border to NC/VA border), (2) Northern North Carolina summer (VA/NC border to Cape Lookout, NC), (3) North Carolina mixed winter (NC coastwide), (4) Southern North Carolina summer (Cape Lookout, NC to Murrell's Inlet, SC), (5) South Carolina annual (Murrell's Inlet, SC to SC/GA border), (6) Georgia annual (coastwide, including estuarine waters), (7) Northern Florida annual (FL/GA border to Indian/Banana River Lagoon), and (8) Central Florida (Indian/Banana River Lagoon south). It is important to note that while there are eight management units, these units correspond to seven distinct bottlenose dolphin stocks -- Northern migratory, Northern North Carolina, Southern North Carolina, South Carolina, Georgia, Northern Florida and Central Florida. The North Carolina winter mixed management represents the winter abundance estimate for the Northern migratory, Northern North Carolina and Southern North Carolina populations combined.

Abundance estimates for each management are outlined in the following table (Table 30). The abundance estimates are derived from 1995 estimates, which incorporate counts conducted by aerial or shipboard surveys, and from photo-identification data combined with mark recapture technology.

In 2002, NMFS conducted surveys to update abundance estimates. Preliminary data from these surveys suggest that its initial abundance estimate of 21,177 animals for the North Carolina winter mixed management unit far exceeds the 1995 estimate of 6,474 bottlenose dolphins. However, this preliminary estimate has not been peer reviewed and is confounded by an overlap in distribution between the coastal

and offshore morphotypes of the bottlenose dolphin population. It is anticipated that the new data and analyses will be peer reviewed in 2003.

Table 30. Estimates of abundance for each management unit of the Western North Atlantic Coastal Bottlenose Dolphins (taken from Palka and Rossman 2001)

Management Unit	Abundance Estimate
Northern Migratory summer (May – October)	5,681
Northern North Carolina summer (May – October)	4,302
Southern North Carolina summer (May – October)	1,298
*North Carolina mixed winter (November – April)	6,474
South Carolina annual	3,513
Georgia annual	7,67
Northern Florida annual	354
Central Florida	10,652

* North Carolina mixed winter represents the winter abundance estimate for the Northern migratory, Northern North Carolina and Southern North Carolina populations combined.

7.5.1.2 North Atlantic Right Whale, *Eubalaena glacialis*

Northern right whales are listed as endangered under the ESA. They are also protected under the MMPA. Hunting is the major reason the western North Atlantic right whale population has declined to less than 300 individuals. Presently, the North Atlantic right whale is considered one of the most critically endangered populations of large whales in the world (Clapham et al. 1999, as cited in Waring et al. 2000). The species was continually hunted off the US East Coast for three centuries possibly reducing its numbers to less than 100 individuals by the time international protection from the League of Nations came into effect in 1935 (see Waring et al. 2000 and reference therein). Right whales have been protected from commercial whaling under legislation of the International Whaling Commission since 1949 (NMFS 1991b).

Western North Atlantic right whales occur in the waters off New England and northward to the Bay of Fundy and the Scotian Shelf during the summer (NMFS 2000b). During the winter, a segment of the population, consisting mainly of pregnant females, migrates southward to calving grounds off the coastal waters of the southeastern US. Right whales use Mid-Atlantic waters as a migratory pathway between their summer feeding grounds and winter calving grounds. During the winters of 1999/2000 and 2000/2001, considerable numbers of right whales were recorded in the Charleston, South Carolina area (Waring et al. 2000). Currently, it remains unclear whether this is typical or reflects a northern expansion of the normal winter range.

Based on photo-identification techniques, the western North Atlantic population size was estimated to be 291 individuals in 1998 (Kraus et al. 2000, as cited in NMFS 2000b). This estimate may be low if animals were not photographed and identified or if animals were incorrectly presumed dead due to not being seen for an extended period of time. The population growth rate estimated for the western North Atlantic population during the late 1980's through early 1990's suggested that the stock was slowly recovering (Knowlton et al. 1994). However, a review of work conducted in 1999 indicated that the survival rate of the northern right whale had declined during the 1990's (Waring et al. 2000). One factor currently under review for this decline is the apparent increase in the calving interval. The mean calving interval pre-1992 was estimated at 3.67 years. An updated analysis using data through the 1997/98 season indicated that the mean calving interval had increased to more than 5 years (Kraus et al. 2000 as

cited in Waring et al. 2000). Reasons under consideration for this shift include contaminants, biotoxins, nutrition/food limitation, disease and inbreeding problems.

The primary sources of human-caused mortality and injury of right whales include ship strikes and entanglement in fishing gear. A recent study estimated that 61.6% of right whales show injuries consistent with entanglement in gear while 6.4% exhibited signs of injury from vessel strikes (Hamilton et al. 1998). With the small population size and low annual reproductive rate, human-caused mortalities have a greater impact on this species relative to other species. As such, due to the overall decline in the western North Atlantic right whale population, the PBR is set at zero (Waring et al. 2000).

7.5.1.3 Harbor Porpoise, *Phocoena phocoena*

The Gulf of Maine harbor porpoise was proposed to be listed as threatened under the ESA on January 7, 1993 (NMFS 1993), but in 1999 NMFS determined this listing was not warranted (NMFS 1999). NMFS removed this stock from the ESA candidate species list in 2001. The harbor porpoise is considered a strategic stock under the MMPA. The PBR for the harbor porpoise is 483 animals (NMFS 1998b). The total fishery-related mortality and serious injury for this stock is not be less than 10% of the calculated PBR, which means the human induced mortality is not approaching zero mortality and serious injury rate. For many years before 1999, the total fishery-related mortality and serious injury exceeded the PBR, therefore it remains listed as a strategic stock.

The harbor porpoise can range from Labrador to North Carolina. The southern-most stock of harbor porpoise is referred to as the Gulf of Maine/Bay of Fundy stock and generally spends its winters in the Mid-Atlantic region. Harbor porpoise are generally found in coastal and inshore waters, but will also travel to deeper, offshore waters. The status of the harbor porpoise stock in US waters is unknown. There is insufficient data to determine the population trends for this species because they are widely dispersed in small groups, spend little time at the surface, and their distribution varies unpredictably from year to year depending on environmental conditions (NMFS 1998b). The best estimate of abundance for the Gulf of Maine/Bay of Fundy harbor porpoise is 89,700. The minimum population estimate is 74,695 individuals (Waring et al. 2002).

7.5.2 Sea Turtles

All sea turtles that occur in US waters are listed as either endangered or threatened under the ESA. The Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and hawksbill (*Eretmochelys imbricata*) are listed as endangered. The loggerhead (*Caretta caretta*) and green turtle (*Chelonia mydas*) are listed as threatened, except for breeding populations of green turtles in Florida and on the Pacific coast of Mexico, which are listed as endangered. All five of these species inhabit the waters of the US Atlantic and Gulf of Mexico.

Atlantic coastal waters provide important developmental, migration, and feeding habitat for sea turtles. The distribution and abundance of sea turtles along the Atlantic coast is related to geographic location, reproductive cycles, food availability, and seasonal variations in water temperatures. Water temperatures dictate how early northward migration begins each year and are a useful factor for assessing when turtles will be found in certain areas. Sea turtles can occur in offshore as well as inshore waters, including sounds and embayments.

7.5.3 Seabirds

Two endangered species of birds the roseate tern and the Bermuda petrel (believed to have a population of less than 200 individuals) may occur in the areas fished for dogfish, however, they are very unlikely to be caught in the fishery. The populations and status of red-throated loons and the black-capped petrels are largely unknown and the common loon is listed by the Fish and Wildlife Service as a species of concern. Common loons breed on lakes where they face a number of hazards including mercury and lead

poisoning, poaching, disturbance, loss of habitat, and capture in freshwater gill net fisheries. The Northern Gannet's populations are stable. In their migration, molting, and wintering habitat along coastal Atlantic waters the loons and gannets the major threat is from gill nets and oil spills.

Two species of alcids, the horned puffin and razorbill breed on islands in Maine and could be caught in gill nets while diving for fish. The razorbill is on the US Fish and Wildlife Service's Species of Concern List. Other birds, including the black-capped petrel and the common loon, that occur in the areas fished are also on the Species of Concern List. While the black-capped petrel is unlikely to overlap with dogfish fishing efforts the common loons have been caught in sunken gill nets throughout the region.

7.6 EXISTING AND PROPOSED FEDERAL REGULATIONS/ACTIONS PERTAINING TO RELEVANT PROTECTED SPECIES

7.6.1 Marine Mammals

7.6.1.1 Bottlenose Dolphin

From November 2001 through May 2002, NMFS convened the Bottlenose Dolphin Take Reduction Team (TRT) in order to develop consensus recommendations to reduce the incidental take and mortality of Atlantic coastal bottlenose dolphin in all Category I and II fisheries. For the purposes of the Team's deliberations, NMFS subdivided the coastal population into eight different management units, partitioned by region and season. These management units are: (1) Northern migratory summer (NJ/NY border to NC/VA border), (2) Northern North Carolina summer (VA/NC border to Cape Lookout, NC), (3) North Carolina mixed winter (NC coastwide), (4) Southern North Carolina summer (Cape Lookout, NC to Murrell's Inlet, SC), (5) South Carolina annual (Murrell's Inlet, SC to SC/GA border), (6) Georgia annual (coastwide, including estuarine waters), (7) Northern Florida annual (FL/GA border to Indian/Banana River Lagoon), and (8) Central Florida (Indian/Banana River Lagoon south). Each management unit was further assigned numbers for estimated stock abundance, potential biological removals (PBR) and bycatch estimates (Table 31).

PBR is defined as the number of human-caused deaths per year each stock can withstand and still reach an optimum population level. This is calculated by multiplying "the minimum population estimate" by "½ stock's net productivity rate" by "a recovery factor ranging from 0.1 for endangered species to 1.0 for healthy stocks." These numbers are gauged against annual bycatch estimates for the management units to determine whether management actions are effective in reducing bycatch below PBR, with the ultimate goal of attaining a zero mortality rate.

Table 31. Estimates of abundance, PBR and bycatch for each management unit of the Western North Atlantic Coastal Bottlenose Dolphins (taken from Palka and Rossman 2001)

Management Unit	Abundance Estimate	PBR	Bycatch Estimate
Northern Migratory summer (May – October)	**5,681**	**23**	**30**
Northern North Carolina summer (May – October)	**4,302**	**16**	**23**
Southern North Carolina summer (May – October)	1,298	4.5	0
***North Carolina mixed winter (November – April)**	**6,474**	**23**	**180**
South Carolina annual	3,513	24	0
Georgia annual	7,67	4.3	0
Northern Florida annual	354	2.3	0
Central Florida	10,652	74	54

* North Carolina mixed winter represents the winter abundance estimate for the Northern migratory, Northern North Carolina and Southern North Carolina populations combined.

The highlighted management units above represent the areas that the TRT focused the greatest amount of effort, since in each area the estimated amount of bycatch exceeded the allocated PBR for that area and fishery (Table 31). Total bycatch is defined as the product of the bycatch rate, takes per unit effort (estimated from a sample of the fishery, and the total effort of the fishery. The Team's consensus recommendations for these areas included gear tending requirements (i.e., proximity rule), limits and prohibitions to overnight sets, and gear marking requirements. In making its recommendations to NMFS, the TRT recognized the positive effect that reductions in spiny dogfish landings have had in reducing bycatch and achieving PBR, particularly within the North Carolina mixed winter management unit. In order to maintain these benefits, the TRT urged that the spiny dogfish fishery remain constrained under the 4 million-pound federal quota.

Since submission of the TRT's consensus recommendations in May 2002, NMFS has released notice of its intent to develop an Environmental Impact Statement, as well as reconvene the Bottlenose Dolphin TRT to develop additional measures that will reduce the mortality and serious injury of coastal bottlenose dolphins to less than PBR. The TRT is scheduled to reconvene in early 2003, with the focus of its deliberations on achieving further reductions in bycatch in the North Carolina winter mixed management unit, the summer Northern migratory management unit and the summer North Carolina management unit.

For additional information, please contact the National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division F/SER3, 9721 Executive Center Drive North, St. Petersburg, FL 33702.

7.6.1.2 Atlantic Right Whale

The Atlantic Large Whale Take Reduction Plan (64 FR 7529; February 16, 1999) addresses the incidental bycatch of large baleen whales, primarily the northern right whale and the humpback whale, in several fisheries including the Northeast sink gill net and Mid-Atlantic coastal gill net. The PBR has been set at zero. Amongst other measures, the plan closes right whale critical habitat areas to specific types of fishing gear during certain seasons and modifies fishing practices. Areas identified as right whale critical habitats include two off of the New England coast (Cape Cod/Massachusetts Bay and Great South Channel) and one off the Southeast coast (Altamaha River, Georgia to approximately Jacksonville Beach, Florida).

The most recent changes to the regulations implemented under the Plan include the implementation of Dynamic and Seasonal Area Management Programs, which close certain areas to fishing during the presence of whales to provide further protection to large whales, particularly right whales.

The Atlantic Large Whale Take Reduction Team continues to identify ways to reduce possible interactions between large whales and commercial gear. Upcoming rules will address additional gear marking and modification provisions to further reduce the risk of entanglement.

Copies of the various rules governing large whale protection are available from the Protected Resources Division, National Marine Fisheries Service, Northeast Region, 1 Blackburn Drive, Gloucester, MA 01930. You can also access additional information regarding the rule and its changes via the Internet at http://www.nero.nmfs.gov/whaletrp/

7.6.1.3 Harbor Porpoise

On December 1, 1998, NMFS published the final rule to implement the Harbor Porpoise Take Reduction Plan for both Gulf of Maine and the Mid-Atlantic coastal waters. The short-term goal of the Plan is to reduce, within six months of the plan's implementation, the mortality and serious injury of harbor porpoises to less than the PBR level. The PBR for harbor porpoises is 483 animals.

The Northeast sink and Mid-Atlantic coastal gill net fisheries are the two fisheries regulated by the Plan (63 FR 66464, December 2, 1998; also refer to for defined fishery boundaries). Amongst other measures, the plan uses time area closures in combination with pingers in Northeast waters, and time area closures along with gear modifications for both small (mesh size greater than 5 inches (12.7 cm) to less than 7 inches (17.78 cm)) and large (mesh size greater than or equal to 7 inches (17.78 cm) to 18 inches (45.72 cm)) mesh gill net in Mid-Atlantic waters. Although the Plan predominately impacts the dogfish and monkfish fisheries due to their higher porpoise bycatch rates, other gill net fisheries are also affected. NMFS has documented observed takes of harbor porpoise in the mesh sizes of 5 inches or less and will be reevaluating observed data for these fisheries and stranding data to reconsider whether management measures are needed to reduce bycatch in these smaller mesh fisheries (63 FR 66464, December 2, 1998).

Copies of the final rule are available from the Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910-3226. You can also access additional information regarding the rule and its changes via the Internet at http://www.nero.nmfs.gov/porptrp/

7.6.2 Sea Turtles

Under the ESA, and its regulations, taking sea turtles – even incidentally – is prohibited, with exceptions identified in 50 CFR 223.206. The incidental take of endangered species may only legally be authorized by an incidental take statement or an incidental take permit issued pursuant to section 7 or 10 of the ESA. No incidental take of sea turtles is currently authorized for any of the gear (i.e., gill net, otter trawl and longlines) used to target spiny dogfish.

Existing NMFS regulations specify procedures that NMFS may use to determine that unauthorized takings of sea turtles occur during fishing activities, and to impose additional restrictions to conserve sea turtles and to prevent unauthorized takings (50 CFR 223.206(d)(4)). Restrictions may be effective for a period of up to 30 days and may be renewed for additional periods of up to 30 days each.

Currently, no sea turtle-related regulations have been implemented that would impact gears targeting spiny dogfish. There are regulations, however, were implemented in March 2002 and impact the use of large mesh gill nets (>8 inches) throughout Virginia and North Carolina. These regulations include one permanent area closure and three seasonal area closures.

Copies of the regulations are available from the Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910-3226.

7.6.3 Seabirds

Under the Migratory Bird Treaty Act it is unlawful "by any means or in any manner, to pursue, hunt, take, capture, [or] kill" any migratory birds except as permitted by regulation (16 USC. 703). The regulations at 50 CFR 21.11 prohibit the take of migratory birds except under a valid permit or as permitted in the regulations. The US Fish and Wildlife Service's Policy on Waterbird Bycatch states "It is the policy of the US Fish and Wildlife Service that the Migratory Bird Treaty Act of 1918, as amended, legally mandates the protection and conservation of migratory birds. Avian conservation is of significant concern to many in the United States. Substantial numbers of waterbirds (especially seabirds, but also waterfowl, shorebirds, and other related wading species) are killed annually in fisheries, making waterbird bycatch a serious conservation issue and a violation of the underlying tenets of the MBTA. The goal of the US Fish and Wildlife Service is the elimination of waterbird bycatch in fisheries. The Service will actively expand partnerships with regional, national, and international organizations, States, tribes, industry, and environmental groups to meet this goal. The Service, in cooperation with interested parties, will aggressively promote public awareness of waterbird bycatch issues, and gather the scientific information to develop and provide guidelines for management, regulation, and compliance." A Working Group is currently developing an action plan for Service-wide review.

7.7 POTENTIAL IMPACTS TO ATLANTIC COASTAL STATE AND INTERSTATE FISHERIES

Regulations under all three take reduction plans for Atlantic large whale, harbor porpoise and bottlenose dolphin have the potential to impact gill net fisheries that harvest spiny dogfish. By far, the plan with the greatest impact is the bottlenose dolphin plan because of the high level of observed take and estimated bycatch that has occurred in that fishery in the past. Since implementation of the federal plan for spiny dogfish in 2000, there have been no documented takes of bottlenose dolphin.

7.8 IDENTIFICATION OF CURRENT DATA GAPS AND RESEARCH NEEDS

7.8.1 Bottlenose Dolphin Research Needs

Stock Identification and Status

- Continued research on stock structure to confirm existing stock delineations and incorporate dolphins in inland waters for improved stock identification.
- Precise abundance estimates over entire range of the coastal morphotype from southern Florida to the New York/New Jersey border, winter and summer, including estuaries.

Improving Assessment of Bycatch Levels

- Increase observer coverage to provide more accurate estimates of fishing related mortality, including the development and use of alternative platforms. Observer coverage should be expanded into state waters.
- Explore and expand stranding networks for collection of data pertinent to bottlenose dolphin/fishery interactions. Include training, equipment, support, and better communication among participants (stranding network members, managers, local authorities, scientists, and fishers).

Gear Modification Research

- Research on the effectiveness of reflective nets for catching fish, as well as for reducing takes of *Tursiops truncatus*.
- Research on comparing the behavior of captive and wild dolphins around gill nets with and without acoustically reflective webbing.

- Investigate the effects of twine stiffness and acoustically reflective webbing on dolphin bycatch.
- Investigate bridle alterations to prevent collapsing of the net and elimination of bridles on anchored gillnet gear with respect to their potential effects on the likelihood of bottlenose dolphin interactions.
- Investigate the behavior of anchored gill net gear with regard to likelihood of entanglement a) when net panels are laced together and b) when they are not laced together, leaving gaps between nets.
- Investigate the effects of different string designs (i.e., shallower net depth, hung in different parts of the water column) to determine if the amount of webbing can be reduced without affecting catch for different fisheries (especially small mesh in coastal waters).
- Determine if dolphins that appear to be attracted to boats or nets in North Carolina waters are interacting with gill net gear, attempt to identify such dolphins, and investigate their behavior and mortality rate.
- Investigate the importance of time of day and time from set with respect to when dolphins are caught in gear, based on carcass temperature and soak times.

7.8.2 Sea Turtle Research Needs

- Research into gear development/deployment for gill nets and trawls of this fishery should be conducted to ensure minimal impact on sea turtles.
- Fishermen should be instructed on handling and resuscitation procedures for turtles encountered in the course of fishing.
- In order to better understand sea turtle populations and the impacts of incidental take in dogfish fisheries, ASMFC and the affected states should support (i.e. fund, advocate, promote) in-water abundance estimates of sea turtles to achieve more accurate status assessments for these species and improve our ability to monitor them.
- ASMFC and the affected states should consider a monitoring program to document incidental take of sea turtles in the spiny dogfish fishery.

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APPENDIX A.1: Risk Analysis of Proposed Rebuilding Strategies

Method

The risk assessment analyzes the impact of variation in the starting conditions (mean survey abundance, 1999-2001) on projections of the constant harvest and constant fishing mortality strategies over the period 2002-2029. The analysis uses 500 bootstraps samples from starting conditions (mean 1999-2001 survey abundance) per management strategy. Probabilities for achieving SSB_{max} for F = 0.28, F = zero, F = 0.03, constant harvest = 8.8 million pounds, and constant harvest = 5.5 million pounds are shown in Table A1-1 and A1-2 and Figure A1-1.

Results

The probability of rebuilding to SSB_{max} under F = 0.28 is near zero throughout the projection. Under the F = zero strategy, the stock has a 50% probability of reaching SSB_{max} in 2013. Both the F = 0.03 and the constant harvest strategy of 5.5 million pounds have similar probability profiles and achieve a 50% probability of reaching SSB_{max} in 2016. Finally, the 8.8 million pound constant harvest strategy rebuilds to SSB_{max} with 50% probability in 2020.

Figure A1-1. Probability of exceeding biomass rebuilding targets for various management strategies.

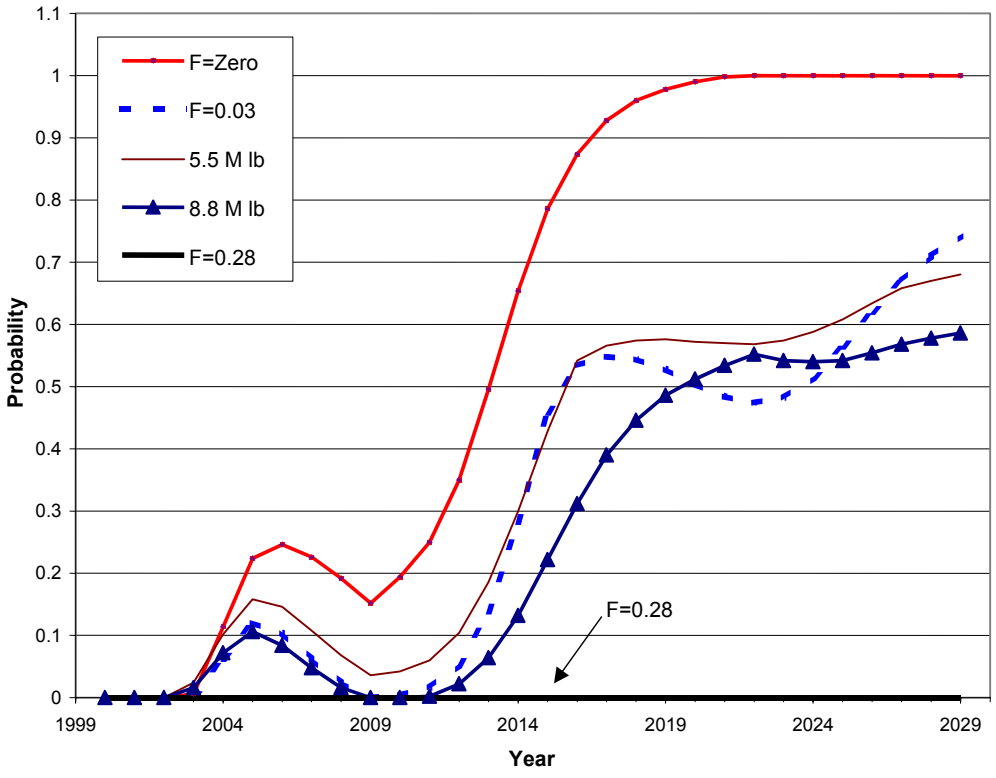

Table A1-1. Probability that the population exceeds SSB_{max} under the proposed management strategies. Shaded cells indicates the first year that the probability of population exceeding SSBmax is 50% or higher.

	PROBABILITY OF EXCEEDING TARGET SSB_{MAX}				
YEAR	STATUS QUO F = 0.28	F = ZERO	F = 0.03	CONSTANT 8.8 MILLION LBS. QUOTA	CONSTANT 5.5 MILLION LBS. QUOTA
2000	0	0.00	0.00	0.00	0.00
2001	0	0.00	0.00	0.00	0.00
2002	0	0.00	0.00	0.00	0.00
2003	0	0.01	0.00	0.02	0.02
2004	0	0.11	0.06	0.07	0.10
2005	0	0.22	0.12	0.11	0.16
2006	0	0.25	0.10	0.08	0.15
2007	0	0.23	0.06	0.05	0.11
2008	0	0.19	0.02	0.02	0.07
2009	0	0.15	0.00	0.00	0.04
2010	0	0.19	0.00	0.00	0.04
2011	0	0.25	0.02	0.00	0.06
2012	0	0.35	0.05	0.02	0.10
2013	0	0.50	0.14	0.06	0.19
2014	0	0.65	0.28	0.13	0.30
2015	0	0.79	0.46	0.22	0.43
2016	0	0.87	0.53	0.31	0.54
2017	0	0.93	0.55	0.39	0.57
2018	0	0.96	0.54	0.45	0.57
2019	0	0.98	0.53	0.49	0.58
2020	0	0.99	0.50	0.51	0.57
2021	0	1.00	0.48	0.53	0.57
2022	0	1.00	0.47	0.55	0.57
2023	0	1.00	0.48	0.54	0.57
2024	0	1.00	0.51	0.54	0.59
2025	0	1.00	0.56	0.54	0.61
2026	0	1.00	0.62	0.55	0.63
2027	0	1.00	0.67	0.57	0.66
2028	0	1.00	0.71	0.58	0.67
2029	0	1.00	0.74	0.59	0.68

(Source: Paul Rago personal communication)

Table A1-2. Year that population rebuilds to SSB_{max} with 50% probability given uncertainty in starting conditions.

STRATEGY	YEAR THAT SSB REBUILDS TO TARGET AT 50% PROBABILITY
Status quo (F= 0.28)	Probability to rebuild is near zero
Constant F=0.03	2016
Constant 8.8 million pound quota	2020
Constant quota, rebuild in same time period as constant F strategy (5.5 million lbs.)	2016

(Source: Paul Rago personal communication)

Probability distributions
The bootstrap results provide an expected frequency distribution of spawning stock biomass for each year in the projection. A wider distribution of expected spawning stock biomass suggests that a given strategy has a wider range of potential outcomes. For example, two strategies may rebuild to the target biomass with equal probabilities in the same year (e.g., 50% probability of rebuilding in year X), yet have different shapes to the frequency distributions (e.g., longer tails). In this case, the probability of rebuilding is the same for both strategies, but the strategy with the wider distribution has some probability of obtaining an outcome that may be outside the range in the other strategy.

The following is a summary of the results from the bootstrap analyses, which can be found in "Status Review of Spiny Dogfish and Risk Analysis of Alternative Management Options" (Rago and Sosebee 2002). The frequency distribution of SSB at status quo F is the narrowest of the options examined and, even more striking, the distribution becomes more truncated in the later years of the projection. This indicates that the response of SSB under the F=0.28 is not sensitive to uncertainty in the survey's starting conditions because the removal rates are higher than reproductive rates. In contrast, the other strategies have frequency distributions that widen over time. Uncertainty in initial conditions of the other strategies is propagated through the projection and variance in the distributions of SSB increase with time. SSB distributions are wider for the constant harvest strategies than the F=0.03. Thus, results from the constant harvest strategies have a broader range of outcomes than the constant F strategy (i.e., the tails of the distributions include SSB that is both higher and lower than the range observed in the constant F strategy). The probability of rebuilding to SSB_{max} under the constant harvest strategy is less precise than the probability associated with rebuilding under the constant F strategy.

Caveats
Bootstrap results do not incorporate uncertainty in effectiveness in implementation (e.g., constant F or constant quota), growth rates, or recruitment in future years in the risk analysis. For example, the probability of rebuilding to biomass target in year x is conditioned on the assumption that constant F=0.03 or a constant harvest of 8.8 million pounds occurs without error upon implementation of management regulations. The projections also assume that the discards to landings ratio remain constant and that recruitment follows the density independent relationship assumed in the projections. Recruitment in recent years has been less than expected for spawning stock biomass.

APPENDIX A.2: SEASONAL ALLOCATION OF THE FISHING YEAR QUOTA

Table A2-1. Derivation of Percentages Attributed to the Semi-Annual Quota Periods.

Historical Landings: 1990-1997 Combined			Coastwide Commerical Quota 4 million pounds *	
Period I	Period II	Total Landings		
May 1 - October 30	November 1 - April 30	from 1990-1997	Period I	Period II
194,369,361	141,372,110	335,741,471		
57.9%	**42.1%**		2,315,703	1,684,297

Source: NMFS Unpublished Weighout Data and North Carolina Trip Ticket System.

* The coastwide commercial quota of 4 million pounds applied to federal waters in the 2001-2002 and 2002-2003 fishing year. Under the Constant Fishing Mortality (F=0.03) Strategy, the coastwide commercial quota may change as the status of the mature females portion of the spawning stock changes.

Table A2-2. Spiny Dogfish Commercial Landings (Pounds) by State and Month, 1990-1997 combined.

		MONTH												
State	Not Categorized	January	February	March	April	May	June	July	August	September	October	November	December	Total
ME		6,006	24,584	14,792	312,176	684,832	3,817,021	6,582,079	4,277,575	2,008,678	680,333	51,691	3,156	18,462,923
NH				2,998	55,250	156,392	1,993,676	3,034,986	2,414,400	682,595	616,931	64,095		9,021,323
MA	1,825,022	919,564	134,095	238,391	3,385,700	11,376,705	24,537,974	42,324,710	35,517,009	25,241,055	19,624,043	9,101,883	3,598,373	177,824,523
RI		2,412,806	222,646	285,181	787,008	627,136	1,042,103	415,782	214,365	91,359	1,426,442	1,917,422	2,216,859	11,659,110
CT	216,854	94,667	56,976	84,859	158,481	70,664	157,796	90,462	36,070	80,049	224,674	234,998	56,282	1,562,832
NY	11,949	233,691	174,551	160,693	216,023	151,645	257,022	154,998	115,748	106,163	462,991	597,473	608,829	3,251,777
NJ		2,403,787	1,834,052	1,866,291	1,676,437	537,437	154,577	53,183	55,410	121,408	1,717,663	6,862,184	5,373,785	22,656,214
DE	62,900												5,710	68,610
MD		7,225,607	4,385,903	5,808,935	3,253,901	33,919	81,728	88		397	1,000	2,295,602	4,817,657	27,904,738
VA	1,146	2,999,811	1,078,659	1,432,833	617,945	216,489	30,327	3,875	5,188	2,214	11,668	728,573	2,505,145	9,633,872
NC		13,709,691	17,845,137	13,844,972	2,099,417	21,180	71	2,950	3,889	3,847	14,389	498,026	7,769,850	55,813,419
Total	2,117,871	30,005,629	25,756,603	23,739,946	12,562,338	13,876,399	32,072,295	52,663,114	42,639,655	28,337,765	24,780,133	22,351,947	26,955,647	337,859,342

Source: NMFS Unpublished Weighout Data and North Carolina Trip Ticket System.

APPENDIX A.3: STATE COMMERCIAL FISHERY REGULATIONS FOR SPINY DOGFISH

*The following table summarizes the state regulations for the commercial spiny dogfish fishery prior to the implementation of the ASMFC interstate fishery management plan for spiny dogfish.

STATE	GEAR RESTRICTIONS	MINIMUM SIZE	PERMIT REQUIREMENTS	FISHING SEASON	OTHER RESTRICTIONS	CURRENT AS OF:
MAINE	None	None	Commercial license required to harvest dogfish for sale. Permit required to collect for research/biomedical use. Annual report to agency required of all research/biomedical use permit holders	None	Commercial harvest in state waters prohibited whenever adjacent federal waters are closed. During commercial closures, the dogfish limit is one per person per day for personal use only.	12/24/2000
NEW HAMPSHIRE			Possession of a permit requires the submission of a monthly report to ED (precise fishing area, type, size and # of gear, hours or days gear was used, weight and quantity of species landed and discarded, month & signature).		Take, landing, possession prohibited when federal fishery closed (quota taken) – dogfish can only be taken for personal use, by angling, can't be sold.	2001
MASSACHUSETTS	-- No night fishing with gill nets. -- Can not set more than 30 300' gill nets at any 1 time. -- No string of gill nets longer than 2,400' total length. -- Gill netters can not land more than 600 lbs without removing all gill nets from the water and placing gear on board. -- 6 ½'' minimum mesh size	None	Fishermen must possess a state issued regulated fishery special permit endorsement for spiny dogfish.	Opens May 1st and follows the federal season	-- Fish dealers must telephone DMF every Monday with landings of dogfish for the previous week. -- 7,000 lb trip limit	3/2002
RHODE ISLAND	None	None	Regular Commercial License applies to the spiny dogfish fishery	Follows the federal season	None	3/2002

STATE	GEAR RESTRICTIONS	MINIMUM SIZE	PERMIT REQUIREMENTS	FISHING SEASON	OTHER RESTRICTIONS	CURRENT AS OF:
CONNECTICUT	None	None	Commercial License Required	See Other Restrictions	Prohibit the taking, possession, and landings of spiny dogfish in CT during any time that federal waters close.	3/21/2002
NEW YORK	None	None	Must possess a New York State Commercial Food Fish License.	Fishing periods: May 1 – October 31 and November 1 – April 30.	-- Must complete a daily Fishing Vessel Trip Report form. -- Harvest and trip limits are based on the federal FMP. -- If quota is taken prior to the end of the fishing period, harvesting and possession will be prohibited. -- NY may close the fishery based on projections of the quota being reached prior to the end of a fishing period. If the quota is not taken prior to the end of the period and the fishery is closed by NY, the remaining quota will be added to the next period.	6/20/01
NEW JERSEY			Federal permit required for state water commercial fishery - fishermen & dealers		Federal or ASMFC closures create an automatic closure to landings in NJ.	
DELAWARE				Closed	Commercial fishery is closed	Spring 2001
MARYLAND			State permit (license) required, as well as monthly reporting		-- No finning -- Closed when RA determines quota has been attained & closes the fishery.	
VIRGINIA	None	None	None	Follows the federal season	Fishery closed when federal quota is reached.	2000
NORTH CAROLINA	None	None	None for state waters	All Year	Commercial harvest closed by Proclamation Authority per ASMFC Emergency Action when federal waters close	11/30/2001

STATE	GEAR RESTRICTIONS	MINIMUM SIZE	PERMIT REQUIREMENTS	FISHING SEASON	OTHER RESTRICTIONS	CURRENT AS OF:
SOUTH CAROLINA	Gill nets over 100 feet in length are not legal (not specifically applicable to spiny dogfish)	None (shark regulations only apply to species in the HMS management unit)	None (There is a state shark permit, but it doesn't apply to spiny dogfish)	All year	None	3/2002
GEORGIA		The 30" TL minimum size applies to the commercial fishery.		All Year	-- Federally permitted fishermen may harvest and land spiny dogfish in excess of the 2 fish small shark composite limit, provided the federal fishery is still open. -- Once the federal quota met and fishery closed, commercial fishermen limited to the creel limit. -- Fish must be landed head and tails in tact; transfer at sea prohibited.	
FLORIDA	None	None	None	None	None	None

APPENDIX A.4: STATE MONITORING PROGRAMS AND RECREATIONAL FISHERY REGULATIONS FOR SPINY DOGFISH

*The following table summarizes the state monitoring programs and regulations for the recreational spiny dogfish fishery prior to the implementation of the ASMFC interstate fishery management plan for spiny dogfish.

STATE	FISHERY INDEPENDENT MONITORING	FISHERY DEPENDENT MONITORING	RECREATIONAL FISHERY REGULATIONS
MAINE	None	No fishery dependent surveys for spiny dogfish except landings data collected by port agents.	When the commercial fishery is closed, any person may fish for, take, possess, or transport one dogfish per day for personal use only.
NEW HAMPSHIRE	None	Monthly harvest reports are submitted by those with a permit. Reports include precise fishing area, type, size and # of gear, hours or days gear fished, weight or quantity of species landed and/or discarded, month and signature.	When commercial fishery is closed, dogfish may only be taken by angling, for personal use and not sold.
MASSACHUSETTS	Bottom Otter Trawl Survey since 1978 in May and September. Collects total weight (kg), total number, and length frequency (cm) by sex for each tow.	Onboard sea sampling for length frequencies in directed fishery (2000: 8 trips – 6 longline, 2 gill net; 2001: 6 longline). Dealer sampling: 15 times (New Bedford) in 2000 measured length frequencies of 1,000 lbs per sampling event. (longline and gill net)	None
RHODE ISLAND	1. Seasonal trawl survey (fall and spring) with 26 random stratified stations in Narragansett Bay, 6 fixed stations in RI Sound & 10 fixed stations in Block Island Sound. 2. Monthly trawl survey at fixed stations - 12 Narragansett Bay and 1 Rhode Island Sound Data collected in both surveys: # of individuals, lengths and aggregate weight. No programs targeting dogfish. Soon to be conducting a gill net survey.	No fishery dependent surveys for spiny dogfish. Collects reported landings. Hopes to put an observer on vessels to collect discard and landings data in the future.	None
CONNECTICUT	Spring/Fall Bottom Trawl Survey: Count/tow since 1984, Weight/tow since 1992. Indices generated for both spring and fall.	Reported landings from vessel logbooks and dealer transactions, including date, area fished, gear, quantity of gear, effort, port landed, disposition, pounds landed and value.	None
NEW YORK	None	None	None – very small recreational fishery when dogfish are present in state waters.

STATE	FISHERY INDEPENDENT MONITORING	FISHERY DEPENDENT MONITORING	RECREATIONAL FISHERY REGULATIONS
NEW JERSEY	Ocean trawl survey, conducted bi-monthly except in mid-winter (5 cruises/year). Not species-specific for spiny dogfish.	All landings are recorded due to federal permit requirements	None
DELAWARE	30' trawl survey at 9 fixed stations in Delaware Bay (March – December) each year. Survey is not continuous, but goes back to '60s.	(Hook & Line)	None
MARYLAND	On vessel monitoring	Catch Reports	None
VIRGINIA	None	Catch Reports	None
NORTH CAROLINA	SEAMAP Cooperative Tagging Cruise: Samples from Cape Lookout, NC to Cape Charles, VA. Sampled spiny dogfish since 1997 – lengths, sex, tagging, and sex ratios.	Landings monitored through a statewide trip ticket program. 1998-2000: Commercial ocean gill net fishery – total length (mm), fork length (mm), aggregate weight (kg) – recorded in fish house from random sample, also recorded location, effort, total weight and composition of landed catch. 1997-2000 Research Project: tagging studies, life history (age and maturity), gill net mesh selectivity and bycatch mortality.	None - No directed recreational fishery – no size limits, creel limits or closed seasons.
SOUTH CAROLINA	No projects directed at fishery independent monitoring. COASTSPAN: (November, December, March) – spiny dogfish sexed & measured – data entered into database. SEAMAP: sexed & measured – data entered into database.	None – no market, no fishery.	None – recreational effort in areas where spiny dogfish occur is relatively light in winter & catches are low.
GEORGIA	Monthly fishery independent trawl assessment of crustaceans; does not intercept spiny dogfish. Fishery independent longlining and hook and line sampling does not intercept spiny dogfish.	Commercial harvest: None – no market, no fishery. Fishery dependent sampling of the trawl fishery (bycatch observations) and TIP program sampling for NMFS had not intercepted any commercial catches of spiny dogfish. None have been reported through the commercial landings trip ticket system.	Regulations for a small shark composite (Atlantic sharpnose, bonnethead, and spiny dogfish): 2 small sharks per person per day possession limit. 30" TL minimum size limit. No seasonal restrictions. Must be landed head & tails in tact; transfer at sea prohibited.
FLORIDA	No dogfish caught in independent surveys.	No dogfish caught in dependent surveys.	None

APPENDIX A.5: STANDARD COMPLIANCE REPORTS

ATLANTIC STATES MARINE FISHERIES COMMISSION

State Reporting Requirements for FMPs

The ISFMP will send out a notice 90 days prior to the report submission deadline requesting submission of the standard report, including any specific compliance requirements as mandated by the FMP. All compliance reports should follow the general format below (Sections I-IV), and include any additional details as specified in Sections 4 and 5 of this document:

I. Introduction

a. Summary of the year: highlight any significant changes in monitoring, regulations, or harvest.

II. Request for *de minimis*, where applicable.

III. Previous year's fishery and management program

a. Activity and results of fishery dependent monitoring (provide general results and references to technical documentation).

b. Activity and results of fishery independent monitoring (provide general results and references to technical documentation).

c. Copy of regulations that were in effect, including a reference to the specific compliance criteria as mandated in the FMP.

d. Harvest broken down by commercial (by gear type where applicable) and recreational, and non-harvest losses (when available).

e. Review of progress in implementing habitat recommendations (if applicable).

IV. Planned management programs for the current fishing year

a. Summarize regulations that will be in effect for the current fishing year.
(Copy of current regulations if different from III c.)

b. Summarize monitoring programs that will be performed.

c. Highlight any changes from the previous year.

V. Plan specific requirements

a. Indicate the number of spiny dogfish exempted fishing permits issued in the previous fishing year, the actual amount (in numbers of fish and pounds) collected under each exempted fishing permit, as well as any other pertinent information (i.e. sex, when and how the spiny dogfish were collected). The report should also indicate the number of exempted fishing permits issued for the current fishing year.