AMENDMENT 12

TO THE

ATLANTIC SURFCLAM AND OCEAN QUAHOG FISHERY MANAGEMENT PLAN

(Includes Draft Environmental Assessment and Draft Regulatory Impact Review)

October 1998

Mid-Atlantic Fishery Management Council

in cooperation with

the National Marine Fisheries Service,

and

the New England Fishery Management Council

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
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APR 28 1999

James Gilford, Chairman
Mid-Atlantic Fishery Management Council
Room 2115 Federal Building
300 South New Street
Dover, DE 19904-2331

Dear Jim;

This letter is to inform you that the National Marine Fisheries Service (NMFS) has partially approved portions of Amendment 12 to the Summer Flounder, Scup and Black Sea Bass Fishery Management Plan (FMP), Amendment 8 to the Atlantic Mackerel, Squids and Butterfish FMP, and Amendment 12 to the Atlantic Surfclam and Ocean Quahog FMP (collectively referred to as the SFA amendments). The portions disapproved based on the national standards and other applicable law, and the reasons for disapproval, are as follows:

- **Scup Rebuilding Schedule**

NMFS disapproves the *finding* presented by the Council that the management measures in place to rebuild the scup fishery are adequate under Sustainable Fisheries Act (SFA) guidelines. Given the general decline of this fishery and the risk prone fishing mortality rate target selected as a F_{MSY} proxy, the rebuilding plan is unacceptably risk-prone. The 27th Stock Assessment Workshop (SAW-27) had suggested a more conservative $F_{0.1} = 0.15$ as a proxy, versus the specified F_{MAX}, currently 0.26. Although the fishing mortality rate portion of the overfishing definition (OFD) is - by itself - conceptually sound, the combination of the less conservative choice of F by the Council and the risk prone rebuilding program warrants disapproval.

The Northeast Fisheries Science Center (Center) certified conditionally this OFD, reaffirming the SAW-27 recommendation that $F_{0.1}$ should be used as a F_{MSY} proxy. The Center noted that greater caution was necessary in setting a fishing mortality threshold for scup. This caution is necessary to accommodate the greater uncertainty in the assessment of scup compared to other species where F_{MAX} has been acceptable. The uncertainty arises especially in the limited discard estimates (pattern of catch-at-age). An alternative way to build in caution is through the rebuilding program. Thus, to address this deficiency, the Council must adopt a precautionary approach when setting specifications to account for lack of information on discards. Given that F_{MAX} is risk prone for this fishery, the rebuilding must be correspondingly risk averse. The biomass threshold proxy of the maximum value of the Northeast Fisheries Science Center (Center) Spring survey spawning stock biomass (SSB) index, the 1977-79 three year moving average of 2.77 kilograms (kg) per tow, is in accordance with advice from SAW-27 for SFA reference points, and complies with the 50 CFR Part 600 guidelines.

- **Scup Bycatch Provision**

NMFS disapproves the bycatch provision for scup as inconsistent with national standard 9. Measures in the current FMP do not reduce adequately bycatch or minimize bycatch mortality. SAW-27 advised reducing F "substantially and immediately" and noted that reducing discards (especially in small mesh fisheries) would have the most impact in that regard. NMFS acknowledges that data with respect to identifying primary discard sources sufficient to implement management measures are limited. Still, it is envisioned that the Council would take the precautionary approach to develop measures to reduce discards as a result of this disapproval.

I support action begun on addressing this issue in the April 27, 1999, workshop held by the Council's Comprehensive Management Committee. This Committee is charged with investigating alternatives to address scup discard, such as gear modification and season/area closures. I encourage this Committee's rapid development of management measures to reduce bycatch in the small mesh fishery.

- **Surfclam Overfishing Definition**

NMFS disapproves the surfclam OFD as inconsistent with national standard 2 (best available science). The amendment specified a B_{MSY} proxy equal to the 1997 biomass for the Northern New Jersey (NNJ) portion of the stock. The Center did not certify that the surfclam OFD complies with the 50 CFR Part 600 guidelines.

With respect to fishing mortality targets, no attempt is made to calculate a global fishing mortality rate that just removes the annual surplus production, F_{PO}. With respect to a biomass threshold, the proposed parameter is based on NNJ biomass and production, and does not take into account the biomass or surplus production in *other* geographical regions. The NNJ area accounts for only 27 percent of current total annual production. Some level of productivity could be sustained in other resource areas, should economic conditions warrant. The proposed proxies, therefore, represent neither *global* values nor the potential long term biological productivity of the resource over its entire range. The OFD is a "local" definition, and creates management implications when applied globally. This disapproval leaves the fishery without an OFD that meets the requirements of the Act. The provision should be revised as soon as practicable.

- **Essential Fish Habitat**

The essential fish habitat (EFH) portions of the SFA amendments are deficient in addressing the requirements of the SFA and EFH regulations regarding gear impacts on EFH. The SFA requires that the Councils "minimize to the extent practicable adverse effects on [EFH] caused by fishing." The EFH regulations at 50 CFR 600.815(a)(iii) require Councils to "act to prevent, mitigate or minimize any adverse effects from fishing, to the extent practicable, if there is evidence that a fishing practice is having an identifiable adverse effect on EFH..." The SFA amendments contain very little discussion of compliance with these requirements.

The SFA amendments suggest that several types of fishing gear have the potential to cause identifiable adverse impacts to EFH; however, the amendments lack a complete assessment of the potential adverse effects of EFH of the gears used in each fishery, as required by 50 CFR 600.015(a)(3)(iii). Moreover, there is insufficient discussion to justify the Council's conclusion that it is not practicable to take measures to minimize these effects. As a result of these deficiencies, the following sections of the SFA amendments were not approved:

- Section 2.2.3.7 Fishing Impacts on EFH and Section 2.2.4 Options for Managing Adverse Effects from Fishing in Amendment 12 to the Summer Flounder, Scup and Black Sea Bass FMP.
- Section 2.2.3.7 Fishing Impacts on EFH and Section 2.2.4 Options for Managing Adverse Effects from Fishing in Amendment 8 to the Atlantic Mackerel, Squids and Butterfish FMP.
- Section 2.2.3.8 Fishing Impacts on EFH,, and Section 2.2.4 Options for Managing Adverse Effects from Fishing in Amendment 12 to the Atlantic Surfclam and Ocean Quahog FMP

In letters to the Council dated September 4, 1998, and October 2, 1998, NMFS identified the need for improvements in these sections of the Amendments and provided specific recommendations. Although the Council attempted to address many of the comments provided by NMFS, the SFA amendments fell short of the requirements set forth in both the SFA and the EFH regulations. I have attached detailed guidance for bringing the EFH portions of the SFA amendments into compliance.

- **Approved Measures**

NMFS approves the remaining measures contained in the SFA amendments. Those measures include:

- The implementation of new or revised overfishing definitions and specifications of optimum yield for the respective species not disapproved. The status determinations for several species may change with the new assessments, based on a review by the SAW at the end of June.
- The designation of essential fish habitat (EFH).
- The addition to each of the FMPs of a framework adjustment process that is separate from the annual specification setting process.
- The requirement that operator in the surfclam and ocean quahog fisheries obtain a permit.
- The vessel size restriction for that Atlantic mackerel fishery.

I appreciate the difficulty of the task the Council undertook in responding to the new requirements of the law. I look forward to working with the Council in the future to address the outstanding issues noted above.

Sincerely,

for Jon C. Rittgers
Acting Regional Administrator

CC: J. Dunnigan

EXECUTIVE SUMMARY

Amendment 12 to the Atlantic Surfclam and Ocean Quahog Fishery Management (FMP), prepared by the Mid-Atlantic Fishery Management Council, is intended to manage the Atlantic surfclam and ocean quahog fisheries pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) of 1976, as amended by the Sustainable Fisheries Act (SFA) in October 1996. The purpose of this Amendment is to bring the Atlantic Surfclam and Ocean Quahog Fishery Management Plan into compliance with the new and revised National Standards and other required provisions of the Sustainable Fisheries Act. In addition, this Amendment would: 1) add a framework adjustment procedure that would allow the Council to modify management measures through a streamlined public review process, and 2) implements an Operator Permit requirement for fishermen that do not already have them for other fisheries.

The FMP modified by this Amendment was implemented in 1977. The management unit is all Atlantic surfclams (*Spisula solidissima*) and ocean quahogs (*Arctica islandica*) in the Atlantic EEZ. The goal of the management plan is to continue the effective management of these two resources while preventing any future overfishing.

Objectives

The objectives of the Atlantic Surfclam and Ocean Quahog Fishery Management Plan (FMP) are:

1. Conserve and rebuild Atlantic surfclam and ocean quahog resources by stabilizing annual harvest rates throughout the management unit in a way that minimizes short term economic dislocations.

2. Simplify to the maximum extent the regulatory requirement of clam and quahog management to minimize the government and private cost of administering and complying with regulatory, reporting, enforcement, and research requirements of clam and quahog management.

3. Provide the opportunity for industry to operate efficiently, consistent with the conservation of clam and quahog resources, which will bring harvesting capacity in balance with processing and biological capacity and allow industry participants to achieve economic efficiency including efficient utilization of capital resources by the industry.

4. Provide a management regime and regulatory framework which is flexible and adaptive to unanticipated short term events or circumstances and consistent with overall plan objectives and long term industry planning and investment needs.

Sustainable Fisheries Act Issues and Management Measures

The Sustainable Fisheries Act of October 1996 (SFA), which reauthorized and amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), made a number of changes to the existing National Standards, as well as to definitions and other provisions in the Magnuson-Stevens Act, that caused the Guidelines for Fishery Management Plans to be significantly revised.

The SFA made significant changes to the Guidelines for National Standard 1 and added three new National Standards, including requirements that FMPs take into consideration the effects on fishing communities (National Standard 8), reduce bycatch (National Standard 9), and promote safety of life at sea (National Standard 10). In addition, the SFA requires the Councils to identify and describe essential fish habitat for species managed under the SFA. The purpose of this Amendment is to bring the Atlantic Surfclam and Ocean Quahog Fishery Management Plan into compliance with the new and revised National Standards and other required provisions of the Sustainable Fisheries Act.

Overfishing Definitions

Atlantic surfclams

The present data are insufficient to estimate accurately B_{MSY} , MSY, or F_{MSY} (section 2.1.4). However, stable yields, absence of change in mean length, successful recruitment, and the rough equivalence of production in Northern New Jersey (NNJ) with harvests, imply that the current policy is at equilibrium with the resource and is likely near the optimum. Neither species is overfished so the new definitions will have little impact.

The new overfishing definition "target" for surfclams will be the 1997 biomass estimate for NNJ as a reasonable proxy for B_{MSY} and the associated F_{P0} (production replacement) level of fishing mortality that would result from an annual catch equal to the annual production of biomass by that NNJ region. The overfishing definition "threshold" would be ½ the B_{MSY} proxy (as recommended by the Applegate *et al.* 1998 Overfishing Definition Review Panel report) with an $F_{20\%}$MSP level of fishing mortality that should never be exceeded. The $F_{20\%}$ MSP level is the threshold level recommended by the NEFSC for Amendment 9 (MAFMC 1996) and reviewed and approved by the MAFMC Scientific and Statistical Committee.

Ocean quahogs

For MSY of ocean quahogs, it is generally assumed that MSY for harvested populations occurs at one-half the virgin biomass. The 1997 surveyed biomass estimate (roughly 3 billion pounds of meats) is at about 80% of the virgin biomass (roughly 4 billion pounds of meats) and exploitation rates are below $F_{0.1}$, $F_{25\%}$, and F_{max}. The combination of current biomass and F is highly unlikely to represent overfishing, as defined by the current SFA guidelines (NEFSC 1998b). There is however, significant time to determine the exact nature of the sustainability of the resource, since total removals (which have averaged about 40 million pounds/year) over the past two decades have only reduced the virgin biomass by about 20%.

The overfishing definition "target" for ocean quahogs is one-half the virgin biomass and the $F_{0.1}$ level of fishing mortality for the exploited region. The overfishing definition "threshold" would be one-half B_{MSY} or one-quarter of the virgin biomass (as recommended by the Applegate *et al.* 1998 Overfishing Definition Review Panel report) with an $F_{25\%}$ MSP level of fishing mortality that should never be exceeded. The $F_{25\%}$ MSP level is the threshold level recommended by the NEFSC for Amendment 9 (MAFMC 1996) and reviewed and approved by the MAFMC Scientific and Statistical Committee.

Essential Fish Habitat Definition

The SFA significantly altered the requirement of FMPs to address habitat issues. The SFA contains provisions for the identification and protection of habitat essential to the production of federally managed species. The Act requires FMPs to include identification and description of essential fish habitat (EFH), description of non-fishing and fishing threats, and suggest conservation and enhancement measures. These new habitat requirements are addressed in this Amendment in section 2.2.

Surfclams: Throughout the substrate, to a depth of three feet below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of all the ranked ten-minute squares for the area where surfclams were caught in the NEFSC surfclam and ocean quahog dredge surveys (Figure 16). Surfclams generally occur from the beach zone to a depth of about 200 feet, but beyond about 125 feet abundance is low.

Ocean quahogs: Throughout the substrate, to a depth of three feet below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of all the ranked ten-minute squares for the area where ocean quahogs were caught in the NEFSC surfclam and ocean quahog dredge surveys (Figure 17). Distribution in the western Atlantic ranges in depths from 30 feet to about 800 feet. Ocean quahogs are rarely found where bottom water temperatures exceed 60 °F, and occur progressively further offshore between Cape Cod and Cape Hatteras.

The management measures adopted by the Council for this Amendment are:

Framework Adjustment Process

In addition to the annual review and modifications to management measures associated with the quota setting process, the Council would like to be able to add or modify management measures through a framework adjustment procedure. This adjustment procedure allows the Council to add or modify management measures through a streamlined public review process. As such, management measures that have been identified in the plan could be implemented or adjusted at any time during the year (with the exception of the annual quotas). The specific management measures that are frameworked include: the overfishing definition (both the threshold and target levels), description and identification of EFH (and fishing gear management measures that impact EFH), habitat areas of particular concern, set aside quota for scientific research, vessel tracking system, and the optimum yield range.

Operator Permit

An operator of a vessel with a permit issued pursuant to this FMP must have an Operator's Permit issued by NMFS. Any vessel fishing commercially for surfclams or ocean quahogs in the EEZ must have on board at least one operator who holds a permit. That operator may be held accountable for violations of the fishing regulations and may be subject to a permit sanction. During the permit sanction period, the individual operator may not work in any capacity aboard a federally permitted fishing vessel.

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1.0 INTRODUCTION

The Sustainable Fisheries Act of October 1996 (SFA), which reauthorized and amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), made a number of changes to the existing National Standards, as well as to definitions and other provisions in the Magnuson-Stevens Act, that caused the Guidelines for Fishery Management Plans to be significantly revised. The SFA made significant revisions to National Standard 1 and added three new National Standards, including requirements that FMPs take into consideration the effects on fishing communities (National Standard 8), reduce bycatch (National Standard 9), and promote safety of life at sea (National Standard 10). In addition, the SFA requires the Councils to identify and describe essential fish habitat for species managed under the SFA.

The purpose of this Amendment is to bring the Atlantic Surfclam and Ocean Quahog Fishery Management Plan into compliance with the new and revised National Standards and other required provisions of the Sustainable Fisheries Act relative to the existing management measures. Specifically, this Amendment revises the overfishing definition for surfclams and ocean quahogs and addresses the new and revised standards relative to the existing management measures. In addition, this Amendment would add a framework adjustment procedure that would allow the Council to modify management measures through a streamlined public review process and implements an Operator Permit requirement for fishermen that do not already have them for other fisheries. The goal of the management plan is to continue the effective management of these two resources while preventing any future overfishing.

1.1 PURPOSE AND NEED FOR ACTION

1.1.1 History of FMP Development

The Mid-Atlantic Fishery Management Council (MAFMC or Council) has been involved in surfclam and ocean quahog management since its first meeting (September 1976), when it was discussed that the surfclam fishery should be the first to have a plan developed. At the February 1977 meeting the Council voted to accept responsibility for the surfclam plan and began discussion of possible management measures. From April through August 1977 every meeting included a debate over possible management measures. Public hearings were conducted during June 1977, with major revisions proposed to the management system based on public comments. The MAFMC developed the original FMP which was approved in November 1977 for the period through September 1979 (MAFMC 1977). Amendment 1 extended it through 31 December 1979. It contained specific quarterly quotas for surfclams (350,000 bushels each for October - December and January - March and 550,000 bushels each for April - June and July - September) and an annual quota (3,000,000 bushels) for ocean quahogs. The effort limitation, permit, and logbook provisions were included. The FMP also instituted a moratorium in the surfclam fishery (all surfclams, since there was no New England Area) for one year to allow time for the development of an alternative limited entry system "such as a stock certificate program" (MAFMC 1977).

Amendment 1 (MAFMC 1979a) extended the FMP for ninety days, until the end of 1979 (primarily to allow for completion of the latest stock assessment). It added processor reporting requirements and removed the requirement that each quarter begin with four days of fishing (even though the stock was depressed, the excess harvesting capacity led to closures very quickly). The moratorium was continued.

Amendment 2 (MAFMC 1979b) extended the FMP through the end of 1981, divided the surfclam portion of the management unit into the New England and Mid-Atlantic Areas. Annual quotas were

25,000 bushels of surfclams for the New England Area, 1,800,000 bushels of surfclams for the Mid-Atlantic Area, 3,500,000 bushels of quahogs for 1980, and 4,000,000 bushels of quahogs for 1981. The quarterly quotas in the Mid-Atlantic Area were moving closer to equal (400,000 bushels for the fall and winter quarters and 500,000 bushels for the spring and summer quarters). The bad weather make up day was introduced. The moratorium was continued in the Mid-Atlantic Area.

Amendment 3 (MAFMC 1981), approved 13 November 1981, extended the FMP indefinitely. A 5.5" surfclam minimum size limit was imposed in the Mid-Atlantic Area. The surfclam fishing week in the Mid-Atlantic Area was expanded to Sunday - Thursday from Monday - Thursday. Quota setting was put on a framework basis with ranges of 1.8 - 2.9 million bushels for Mid-Atlantic Area surfclams, 25,000 - 100,000 bushels for New England Area surfclams, and 4 - 6 million bushels for ocean quahogs. The Council proposed a permit limitation system to replace the moratorium which was disapproved by NMFS; NMFS extended the moratorium.

Amendment 4 was initiated in response to a closure of the New England Area to surfclam fishing during the second half of 1983. On 21 July 1983 the New England Council sent a letter to the Secretary of Commerce requesting Secretarial action to reopen the New England Area surfclam fishery. The Mid-Atlantic Council passed a motion in August 1983 recommending that the Secretary not accept the proposal of the New England Council. After receiving a letter from the Secretary on 6 September 1983 denying implementation of emergency action to reopen the surfclam fishery in the New England Area, work was begun to investigate methods for avoiding an extended closure in 1984. In November 1983 the Mid-Atlantic Council passed a motion authorizing the Regional Administrator and the New England Council to prepare an Amendment for the New England Area involving trip limits, quarterly quotas, or similar strategies to insure fishing throughout the year. A proposed Amendment 4 was drafted by the New England Council staff in cooperation with NMFS staff and hearings were held on 21 and 22 March 1984. At a joint meeting of the New England and Mid-Atlantic Councils in May 1984 representatives of the surfclam industry from both New England and the Mid-Atlantic presented revisions to the proposed regime. The Mid-Atlantic Council passed a motion to adopt the proposed Amendment 4 to the Surfclam and Ocean Quahog FMP as amended to provide that any unharvested portion of a bimonthly allocation be added to the immediately following bimonthly allocation rather than being prorated over all remaining bimonthly periods and that trip and weekly limits be by vessel classes based on relative fishing power using the following ratios: Class 1 = 1.0, Class 2 = 1.8, and Class 3 = 3.4, and that NMFS use a rulemaking procedure to implement the Amendment on an emergency basis. The New England Council voted at the same meeting to adopt the Amendment.

The provisions of Amendment 4 were implemented on an emergency basis for 180 days beginning 1 July 1984, during which time the Amendment was finalized by the New England Council and submitted for Secretarial approval. However, it was determined that the document was not structurally complete for review.

Amendment 5 (MAFMC 1984), approved 28 February 1985, allowed for revision of the surfclam minimum size limit provision, extended the size limit throughout the entire fishery, and instituted a requirement that cages be tagged.

Amendment 6 (MAFMC 1986) was begun in October 1984 following an exploratory fishery conducted on Georges Bank as a result of emergency regulations published 2 August 1984 (49 *FR* 30946 - 30948), primarily to address problems associated with the development of a surfclam fishery on Georges Bank. At its October 1984 meeting the Council voted to divide the New England Area into the Nantucket Shoals and Georges Bank Areas, the dividing line being 69° longitude. At the same meeting the Council voted to approve revising proposed Amendment 4 so its provisions applied to that portion of the New England Area west of 69° longitude.

In response to the Council's recommendation that Amendment 4 be revised to apply only to that portion of the New England Area west of 69° longitude, the New England Council held a hearing on 11 December 1984.

At its December 1984 meeting the Council adopted the provisions of Amendment 6. The Amendment was adopted by the Council for hearings in January 1985, with hearings held 18 and 19 February 1985. The Council adopted Amendment 6 for Secretarial approval at its March 1985 meeting. At that time Amendment 4 still had not been found structurally complete. Given the relationship between the provisions of Amendments 4 and 6, the decision was made to abandon Amendment 4 and that the Mid-Atlantic Council would combine the provisions of Amendment 4 with the Mid-Atlantic Council's Amendment 6 in one document. The combination of Amendments 4 and 6 did not change any substantive provisions of either Amendment.

The Council was notified via a letter of 25 July 1985 that NMFS had partially approved Amendment 6. The letter from Acting Regional Administrator Richard Schaefer to Council Chairman Robert Martin stated in part that:

"The measures in Amendment 6 that I disapproved are the Nantucket Shoals Area bimonthly quota guidelines and effort control measures, the one landing per day restriction applying to the Mid-Atlantic Area, the provision prohibiting the Regional Director from subdividing allowable fishing hours when the hours are set at 12 or less, and the portion of the notification provision prohibiting vessels that have fished in a notification zone from returning to fish in the same notification zone within that calendar month. The disapproval of the bimonthly guidelines for Nantucket Shoals removed the basis for adjusting the quotas between bimonthly periods when harvest either exceeds or falls short of quota. Therefore, this provision, while not specifically disapproved, can not be implemented on Nantucket Shoals at this time." (This measure was one developed jointly by the New England Council and the NMFS Northeast Regional Office.)

The Council revised Amendment 6 to replace the bimonthly quotas with quarterly quotas, eliminate the weekly landing limits for the Nantucket Shoals Area, clarify the quota adjustment provisions for the Nantucket Shoals and Georges Bank Areas, and present additional justification for the one landing per trip provision. The other disapproved provisions (prohibition on subdividing allowed fishing times under certain conditions and portions of the notification system) were deleted from the Amendment. The Amendment was approved on 9 April 1986 when the 60-day review period expired without action by NMFS.

Amendment 7 (MAFMC 1987) was developed to change the quota distribution on Georges Bank (from 10:40:40:10 to equal quarterly quotas) and revise the roll over provisions from one period to the next. This Amendment was taken to public hearings in February 1987, approved by NMFS, and final regulations published on 24 July 1987.

Amendment 8 (MAFMC 1988) established an individual transferable quota (ITQ) system primarily to replace the regulated fishing time system in place in the mid-Atlantic surfclam fishery. This fishery was operating under a moratorium on vessel permits. Allowable fishing time in this fishery went from 96 hours a week in 1978 to six 6 hour trips per quarter in 1988. The ITQ system essentially converted allowable fishing time into allowable individual levels of harvest. The Council had several alternatives under consideration during the development of Amendment 8 with respect to management of the New England surfclam fishery and the ocean quahog fishery. These fisheries were controlled through quotas prior to Amendment 8. The ocean quahog quota has never been fully harvested. Many felt that the Council should simply impose a moratorium on this fishery until such time as restraints on harvest were necessary. When such restraints were necessary, an ITQ system could be imposed based on reported landings. The Council decided to bring the ocean quahog fishery under the ITQ system because it believed that the problems experienced in the surfclam fishery under the moratorium would simply be relived under a quahog moratorium.

The vessel owners that received allocation under the ITQ system were those whose vessels had reported landings under the mandatory logbook requirement that had been in place since 1978. All of the vessels that had reported landings were those that were involved in the commercial surfclam and ocean quahog fisheries prosecuted mainly off the Mid-Atlantic. These fisheries involve large vessels towing hydraulic dredges the catch from which is emptied into metal cages holding roughly 32 bushels. These cages are the industry standard that enables processors to handle large volumes of product given the limitations of processing plant size, vessel capacity, and stability as well as that of moving and hauling equipment.

Amendment 8 employed three formulae that gave participants in the Mid-Atlantic surfclam fishery, the New England surfclam fishery and the ocean quahog fishery, respectively, an allocation percentage. Initial allocation percentages were based largely on a vessel's average historical catch. The average catch was weighted with respect to Mid-Atlantic surfclam allocations and a vessel size factor was added in to calculate the initial allocation percentage. This percentage was applied to the annual quota to give the participant his/her allocation in bushels. This number was again divided by 32, the number of bushels in a standard cage used by the industry to determine the number of cage tags the participant was to be issued by the National Marine Fisheries Service.

A traditional EEZ participant's bushel allocation will change in any year if the annual quota is revised. Since these allocations may be bought and sold, a participant's allocation may change as he/she purchases or sells allocation. Each transfer of allocation must be approved by the Regional Administrator. Allocation permits are modified by NMFS to reflect modifications to the participant's allocation percentage following a transfer of allocation. Monitoring the harvest of individual allocations and, in turn, the annual quota is facilitated by a cage tagging requirement and mandatory reporting by vessel owners and dealers with respect to the amount of surfclams and ocean quahogs landed and purchased. Amendment 8 also: (1) allows for the minimum surfclam size to be suspended from year to year; (2) merges the New England and Mid-Atlantic surfclam areas into one management area; (3) authorizes the Regional Administrator to issue shucking-at-sea permits to owners of surfclam vessels based upon certain conditions; and (4) empowers the Regional Administrator to authorize an experimental fishery to gather information necessary for management.

Amendment 9 (MAFMC 1996) was developed to revise the overfishing definitions in response to a scientific review by NMFS (Rosenberg *et al.* 1994). The overfishing definitions were changed from an MSY based definition to a percentage maximum spawning potential (MSP) definition. The Amendment 9 overfishing definition for surfclams was a fishing mortality rate of $F_{20\%}$ (20% of the maximum spawning potential, or MSP), which equated to an annual exploitation rate of 15.3%. The Amendment 9 overfishing definition for ocean quahogs was a fishing mortality rate of $F_{25\%}$ (25% of the MSP), which equated to an annual exploitation rate of 4.3%.

Amendment 10 (MAFMC 1998) which was approved in May of 1998 provided management measures for the small artisanal fishery for ocean quahogs off the northeast coast of Maine which had been operating as an experimental fishery since 1990. As Individual Transferrable Quota (ITQ) management, through Amendment 8 in 1990, was implemented for surfclams and ocean quahogs, it was discovered that the Maine inshore ocean quahog, or "mahogany quahog," fishery that occurred on the same species (*Arctica islandica*) was moving out of state waters into the Exclusive Economic Zone. This created a problem, in that the Magnuson-Stevens Fishery Management and Conservation Act mandates that "to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination" (National Standard 3). The small-scale eastern Maine ocean quahog fishery differed profoundly from the large-scale industrial EEZ ocean quahog fishery that occurs south of Georges Bank in numerous respects. The management tools developed during the first twenty years of federal management for surfclams and ocean quahogs did not fit the Maine fishery well. In 1990, the Regional Administrator granted experimental status to the eastern Maine ocean quahog fishery in order to avoid the potential adverse impacts which would have resulted from the imposition of regulations which were not designed for a small artisanal fishery. The experimental fishery status was granted to the Maine ocean quahog fishery until a better and more permanent solution could be found.

Amendment 10 provided that solution and fully integrated the historical Maine fishery into the Surfclam and Ocean Quahog FMP since the expiration of the experimental fishery on 30 September 1997. There was little known about the extent and abundance of the portion of the ocean quahog resource off of the coast of Maine, and because of this lack of knowledge Amendment 10 established an initial maximum quota for ocean quahogs caught in a zone of both state and federal waters off the eastern coast of Maine north of 43° 50' north latitude. This initial maximum quota for this zone is not to exceed 100,000 Maine bushels, where 1 Maine bushel = 1.2445 cubic feet. Adjustments to the quota can be made in subsequent years within the range of 100,000 and 17,000 Maine bushels as part of the annual quota setting process. Once a survey and assessment has determined a long-term, biologically-sustainable quota for this zone, the FMP will be modified to reflect this new quota. Amendment 10 established a moratorium on entry to the Maine EEZ fishery zone. The moratorium is to be maintained until it is eliminated or replaced with an alternative management program in a subsequent Amendment. It is the Council's intention that such a change would preferably be made in concert with a new assessment-based quota. The Amendment established criteria for continued participation in this zone (north of 43° 50' north latitude) which requires that a vessel must have reported harvesting at least one bushel of ocean quahogs from this zone while participating at least once in the experimental fishery (October 1990 through September 1997). Vessels which had not participated in the experimental fishery or which had not landed at least one bushel of ocean quahogs from this zone during the past seven years, are eligible to fish in the State of Maine waters only or may use their ITQ allocation. Existing ITQ holders are permitted to fish within the EEZ portion of this zone as long as they use their ITQ allocation. All landings from moratorium permitted vessels and State of Maine only permitted vessels count against the initial maximum quota. Landings of ITQ allocation will not count against the initial maximum quota. All State of Maine only permitted vessels and all moratorium permitted vessels must land in Maine and comply with all the State of Maine landing laws. Amendment 10 provided for the protection of public health by restricting harvesting of ocean quahogs in this zone to only those areas surveyed and certified to be free of the organisms which cause PSP. An ITQ vessel may land in Maine (and thus must comply with Maine laws) or may land outside of Maine, but must have the catch certified safe for human consumption through testing at facilities with a NMFS/FDA/state approved dockside Paralytic Shellfish Poisoning (PSP) testing protocol. The principal intent of the Amendment was to allow the artisanal nature of this fishery to continue while promoting appropriate conservation and management of the resource.

Amendment 11 (NMFS 1998) was drafted to achieve consistency among Mid-Atlantic and New England FMPs on vessel replacement and upgrade provisions, permit history transfer and splitting and renewal regulations for fishing vessels issued Northeast Limited Access Federal Fishery permits. As of this date, this Amendment has not been submitted to the Secretary for approval. It is the intent of the Council, that any management measures implemented by earlier amendments and not specifically referenced herein are intended to continue in force.

1.1.2 Problems for Resolution

The SFA revised National Standard 1 and added three new National Standards, including requirements that FMPs take into consideration the effects on fishing communities (National Standard 8), reduce bycatch (National Standard 9), and promote safety of life at sea (National Standard 10). These new National Standards are addressed in this Amendment in sections 3.1.3.8, 3.1.3.9, and 3.1.3.10. No management measures are proposed for any of these three new National Standards.

1.1.2.1 Revised definitions of overfishing required under the SFA

The 1996 Magnuson-Stevens or SFA imposed new requirements concerning definitions of overfishing in US fishery management plans. To comply with National Standard 1 section 3 (29) of the SFA requires that each Council FMP define both overfishing and overfished as a rate or level of fishing mortality that jeopardizes a fisheries' capacity to produce maximum sustainable yield (MSY) on a continuing basis. The proposed guidelines for implementation of the new National Standards suggest that sustainability or the phrase "on a continuing basis" are generally accepted to mean an average stock level and/or average potential yield from a stock over a long period of time. Each FMP must specify an MSY, and a harvest strategy that, if implemented, is expected to result in long-term average yield close to MSY. Section 2.1.4 discusses the long-term sustainability of these two resources and how the Council has managed to prevent any overfishing during the past twenty years of federal management.

1.1.2.2 Essential fish habitat

The SFA significantly altered the requirement of FMPs to address habitat issues. The SFA contains provisions for the identification and protection of habitat essential to the production of federally managed species. The Act requires FMPs to include identification and description of essential fish habitat (EFH), description of non-fishing and fishing threats, and suggest conservation and enhancement measures. These new habitat requirements are addressed in this Amendment in section 2.2.

1.1.2.3 Framework adjustment process

The current plan only allows management measures to be adjusted annually without an Amendment. In addition to this annual review and modifications to management measures associated with the quota setting process, the Council will be able to add or modify management measures through a framework adjustment procedure. This adjustment procedure allows the Council to add or modify management measures through a streamlined public review process. As such, management measures that have been identified in the plan could be implemented or adjusted at any time during the year (with the exception of the annual quotas). The specific management measures that are frameworked include: the overfishing definition (both the threshold and target levels), description and identification of EFH (and fishing gear management measures that impact EFH), habitat areas of particular concern, set aside quota for scientific research, vessel tracking system, and the optimum yield range.

1.1.2.4 Operator Permits

All of the other MAFMC FMPs require commercial (at a minimum) operator permits. The Surfclam and Ocean Quahog FMP has not had a recent major Amendment where operator permits could have been included. An operator of a vessel with a permit issued pursuant to this FMP must have an

Operator's Permit issued by NMFS. Any vessel fishing commercially for surfclams or ocean quahogs in the EEZ must have on board at least one operator who holds a permit. That operator may be held accountable for violations of the fishing regulations and may be subject to a permit sanction. During the permit sanction period, the individual operator may not work in any capacity aboard a federally permitted fishing vessel.

1.1.3 Management Objectives

1. Conserve and rebuild Atlantic surfclam and ocean quahog resources by stabilizing annual harvest rates throughout the management unit in a way that minimizes short term economic dislocations.

2. Simplify to the maximum extent the regulatory requirement of clam and quahog management to minimize the government and private cost of administering and complying with regulatory, reporting, enforcement, and research requirements of clam and quahog management.

3. Provide the opportunity for industry to operate efficiently, consistent with the conservation of clam and quahog resources, which will bring harvesting capacity in balance with processing and biological capacity and allow industry participants to achieve economic efficiency including efficient utilization of capital resources by the industry.

4. Provide a management regime and regulatory framework which is flexible and adaptive to unanticipated short term events or circumstances and consistent with overall plan objectives and long term industry planning and investment needs.

1.1.4 Management Unit

The management unit is all surfclams (*Spisula solidissima*) and all ocean quahogs (*Arctica islandica)* in the Atlantic EEZ. Amendment 10 also established a management regime specific to the eastern Maine fishery for a zone north of 43° 50' north latitude that recognizes the fundamental social, economic and biological characteristics of that segment of the ocean quahog fishery.

1.1.5 Management Strategy

The management strategy for this Amendment is to provide the information and evaluations necessary to meet the Congressional mandates associated with the SFA. Effective federal fishery management of surfclams and ocean quahogs has occurred for the past two decades. The Council intends to continue to prevent overfishing and meet the purposes specified in the SFA.

1.2 PROPOSED AND ALTERNATIVE MANAGEMENT MEASURES

1.2.1 Proposed Management Measures

In addition to SFA requirements, the Council is proposing two new management measures in this Amendment to meet the new mandates of the SFA (a complete description of these management measures is given in section 3.1). These preferred alternatives are as follows:

1. Implement a framework adjustment process.

2. Implement Operator Permits as required in all other MAFMC FMPs.

1.2.2 Non Preferred Management Measures

The only non preferred management measure considered is the "No Action Alternative". This would mean that the Congressionally mandated requirements of the 1996 SFA would not be met.

2.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

2.1 DESCRIPTION OF THE STOCK

2.1.1 Species Description and Distribution

The Atlantic surfclam occurs both in state waters and the US EEZ along the Atlantic seaboard from Maine through North Carolina (Figure 1). Surfclams have planktonic larvae which may disperse sufficiently to cause gene flow throughout this geographical range. Variation in shell morphology along the coast has been reported (NEFSC 1998a).

Ocean quahogs are distributed on both sides of the Atlantic from the Bay of Cadiz of Southwest Spain intermittently across the North Atlantic and down the North American coast to Cape Hatteras. Commercial concentrations occur throughout the continental shelf area between Georges Bank and Cape Hatteras, at least to depths of 250 feet (Figure 2). They also occur in deeper water, but quantitative surveys of abundance have not yet been conducted. Some concentrations also exist in the Gulf of Maine. No explicit studies of stock definition have been undertaken. However, given the extended larval life span of ocean quahogs, animals on the southern shelf are likely components of a single population. Life history differences between Gulf of Maine and the ocean quahogs south of Georges Bank exist; environmental factors may play a large role in producing these differences (NEFSC 1998b).

2.1.2 Abundance and Present Condition

The EEZ surfclam resource is at a medium level of biomass and is probably under-exploited overall. The vast majority of the catch (>80%) is currently derived from the Northern New Jersey (NNJ) area (Figure 3), which contains about 36% of the coast-wide resource (NEFSC 1998a). Large fractions of the resource are exploited at low levels (Delmarva containing 25% of the resource) or not at all (Georges Bank containing 26% of the resource). From 1991 to 1997, a period for which effort has been reported accurately, landings per unit effort (LPUE) off NNJ declined 30% from 2,344 pounds/hr to 1,642 pounds/hr (Figure 4) as the fishery has expanded offshore to the geographic limits of the resource in that area. NEFSC dredge survey data from the same time period do not show a clear trend (NEFSC 1998a). For the resource as a whole, estimated exploitation rates range from 1% to 3%. In NNJ, the estimated exploitation rates range from 2% to 6%. Survey age composition data for NNJ and Delmarva indicate that the populations contain at least 18 cohorts, none of which are dominant (Figure 5). Based on the 1997 data, the average size and yield from clams of the Delmarva region are less than from NNJ (NEFSC 1998a). Georges Bank (GBK) continues to be closed to harvesting due to previous contamination by PSP. Although a significant fraction of the total stock biomass is on GBK, the amount is probably overestimated because rock and boulder habitats have been included in the estimate of that region's area. Between 74% and 91% of the EEZ landings have been taken from NNJ in every year from 1986 to 1997. The current exploitation rate does not exceed threshold or target fishing mortality or current overfishing definitions ($F_{20\%}$ = 0.18) from Amendment 9 (MAFMC 1996).

The ocean quahog resource in surveyed EEZ waters from Southern New England (SNE) to Delmarva (DMV) is at a medium-high level of biomass and, according to the existing overfishing definition

Amendment 9 (MAFMC 1996), would be considered under exploited at the scale of the management unit. However, CPUE has declined substantially in localized areas (Figures 6 and 7). Analysis of data from the 1997 survey, coupled with an estimate of dredge efficiency, led to revised estimates of ocean quahog biomass by region. These estimates are greater than those reported at SAW-19, which were derived only from trends in commercial CPUE from fished areas. Ocean quahogs exist in and are being harvested from waters deeper than those surveyed in 1997, but the magnitude of that portion of the resource is currently unknown. About 30% of the surveyed stock biomass is on Georges Bank (GBK), and this region continues to be closed to harvesting due to previous contamination by PSP. Current harvests represent a small fraction (2% per year) of the surveyed biomass in exploited Mid-Atlantic regions (SNE to DMV). The overall fishing mortality rate (F) in those regions was 0.021 in 1997, which is below the current overfishing definition ($F_{25\%}$ = 0.042). The stock in the EEZ off the coast of Maine continues to be harvested, and to date neither NMFS nor the State of Maine has surveyed this region.

2.1.3 Ecological Relationships and Stock Characteristics

2.1.3.1 Spawning and early life history

There is no reason to update this section from the information presented in Amendment 8 (MAFMC 1988).

2.1.3.2 Age and growth

Growth is not uniform over the year; temperature significantly affects surfclam growth, physiology, and behavior. Henderson (1929) determined the upper lethal temperature of surfclams to be 98.6 °F (37 °C), however, this was based on only 5 individuals. Mid-Atlantic surfclams reared in Georgia did not survive temperatures above 82 °F (28 °C; Spruck *et al.* 1995). Surfclams rarely encounter such temperatures in the field, and are usually found in areas where the bottom temperature rarely exceeds 77 °F (25 °C). The minimum temperatures experienced by surfclams are probably not less than 33 °F (1°C). Ambrose *et al.* (1980) noted that growth of surfclams in the Middle Atlantic Bight was positively correlated with temperature and negatively correlated with variation in temperature. Davis *et al.* (1997) found that growth in the coastal Gulf of Maine was higher at warmer temperatures and higher chlorophyll *a* concentrations. Stable oxygen isotopes revealed that shell growth reflects seawater temperature; growth is most rapid in spring/early summer, slow in late-summer and fall, and extremely slow or non-existent in winter in New Jersey waters (Jones 1983). In the laboratory, surfclam heart rate increased with increasing temperature from 41-59 °F (5-15 °C; deFur and Mangum 1979).

Longevity is an interesting discovery about ocean quahogs. One probably lived for 225 years, making it the longest lived, slowest growing bivalve known (MAFMC 1988). Based upon size composition data and age-size relationship, it is apparent that a significant proportion of the ocean quahog population is in excess of 100 years old. Little new aging information has been developed since the thorough summary in Amendment 8 (MAFMC 1988).

2.1.3.3 Mortality

Fishing mortality for surfclams for the Northern New Jersey region, where 74-91% of the catch is typically taken, mean F = 0.04 (NEFSC 1998a). This is based on total regional biomass. If uncertainty in the survey estimate of mean biomass per tow is considered, then the 95% confidence interval for the average F is {0.03 - 0.05}. Taking into account uncertainty in dredge efficiency, the

95% confidence interval for this average F is {0.02 - 0.06}. Other regions, which are largely unfished, had smaller estimated Fs (NEFSC 1998a).

The assumed natural mortality for surfclams, M = 0.05, should be reconsidered in the next full assessment (NEFSC 1998a).

Fishing mortality for ocean quahogs for 1997 was estimated to be 0.021 for the exploited region (Southern New England through Delmarva) (Figure 6). Based on the 95% confidence interval (CI) associated with stock biomass in that region, the CI for F_{97} is 0.014 - 0.036. Point estimates of F_{97} by region are 0 (GBK), 0.035 (SNE), 0.013 (LI), 0.018 (NJ), 0.019 (DMV), and 0 (SVA/NC). F_{97} for the entire surveyed stock, including unexploited GBK, is 0.014.

The assumed natural mortality for ocean quahogs, M = 0.02, is imprecisely known.

2.1.3.4 Food and feeding

Surfclams and ocean quahogs are planktivorous siphon feeders. Feeding is intimately related with the currents of water drawn in through and expelled from the siphons for respiratory and excretory purposes, since the water may carry food particles eventually ingested by the organism. There is no reason to update this section from the information presented in Amendment 8 (MAFMC 1988).

2.1.3.5 Predators and competitors

Surfclams have many predators (Weissberger *et al.* 1998a), including the naticid snails *Euspira heros* and *Neverita duplicata* (Franz 1976), the sea star *Asterias forbesi* (Meyer *et al.* 1981), the lady crab *Ovalipes ocellatus* and the Jonah crab *Cancer borealis*, the haddock *Melanogrammus aeglefinus* and the cod *Gadus morhua*, and the horseshoe crab *Limulus polyphemus*. The sevenspine bay shrimp *Crangon septemspinosa* preys on recently settled clams. In the New York Bight, crabs accounted for 48.3-100% of mortality while moon snails accounted for only 2.1% of mortality.

Many animals prey on ocean quahogs (Weissberger *et al.* 1998b). Invertebrate predators include rock crabs, sea stars, and other crustaceans. Teleost predators of ocean quahogs include longhorn sculpin, *Myoxocephalus octodecemspinosus*, ocean pout, *Macrozoarces americanus*, haddock, cod, and sculpin. Medcof and Caddy (1971) noted many predators feeding on ocean quahogs damaged by a dredge. These included cod, winter flounder, sculpin, skates, moon snails, and hermit crabs. Other potential predators, including eelpout, sea stars, and whelks, were seen in the dredge tracks, but not observed feeding.

2.1.3.6 Parasites, diseases, injuries and abnormalities

Surfclams are susceptible to several parasites, including the thigmotrich *Sphenophyra dosinae*, the cyclopoid copepod *Myocheres major*, a cestode of the genus *Echeneribothrium*, a nematode tentatively identified as *Paranisakiopsis pectinis*, and the hyperparasite haplosporidian *Urosporidium spisuli.* There is no reason to update this section from the information presented in Amendment 8 (MAFMC 1988).

2.1.4 Maximum Sustainable Yield

The SFA requires that management achieve the optimum harvest from each fishery. The annual harvest level must be less than or equal to that based on an MSY (maximum sustainable yield) and the biomass must be greater than or equal to that which produces MSY. The current overfishing definitions for surfclams and ocean quahogs, as defined in Amendment 9 (MAFMC 1996) need some revision because they are based on a fishing mortality rate thought to minimize the potential for recruitment overfishing ($F_{20\%}=0.18$ for surfclams and $F_{25\%}=0.042$ for ocean quahogs), rather than an MSY strategy. There are no biomass estimates associated with either the target or threshold overfishing levels defined by Amendment 9 (MAFMC 1996).

Overfishing prior to Amendment 9 was defined as the catch of surfclams or ocean quahogs that exceeded the annual quota for each species. The provisions of the FMP concerning annual quotas, vessel allocations, cage tags, minimum size limit, closed areas, and reporting had prevented overfishing, given the existing stock conditions during the first two decades of management for these two species. Prior to Amendment 9 the NMFS concluded that the MSY-based/relatively constant harvesting strategy used as the previous overfishing definition was no longer acceptable since it depended on the Council taking appropriate action rather than relying on a quantifiable rate-based standard.

The Amendment 9 overfishing definition for surfclams was a fishing mortality rate of $F_{20\%}$ (20% of the maximum spawning potential, or MSP), which equated to an annual exploitation rate of 15.3%. The Amendment 9 overfishing definition for ocean quahogs was a fishing mortality rate of $F_{25\%}$ (25% of the MSP), which equated to an annual exploitation rate of 4.3%.

Alternative overfishing definitions that were considered for surfclams in Amendment 9 were:

1. A fishing mortality rate of F_{max}, which corresponded to an annual exploitation rate of 16.5%, and

2. The Council's surfclam quota setting policy, which was:
   OY = 1,850,000 - 3,400,000 bushels. Council policy is to set the quota within the OY range at a level that will allow fishing to continue at that level for at least 10 years. Within the above constraints, the quota is set at a level that will meet estimated annual demand.

Alternative overfishing definitions that were considered in Amendment 9 for ocean quahogs were:

1. A fishing mortality rate of $F_{20\%}$, which corresponded to an annual exploitation rate of 5.8%.

2. A fishing mortality rate of $F_{30\%}$, which corresponded to an annual exploitation rate of 3.5%.

3. A fishing mortality rate of F_{max}, which corresponded to an annual exploitation rate of 6.8%, and

4. The Council's ocean quahog quota setting policy, which was:
   OY = 4,000,000 - 6,000,000 bushels. The Council policy is to set the quota within the OY range at a level that will allow fishing to continue at that level for at least 30 years. Within the above constraint, the quota is set at a level that will meet estimated annual demand.

The Council has had a 10 year supply horizon for surfclams and a 30 year supply horizon for ocean quahogs as its policy for annual quota setting for nearly a decade. The overfishing level defined in Amendment 9 was a "threshold" beyond which the long-term productive capability of the stock is jeopardized. It was concluded in Amendment 9 that the Council's quota setting process is more conservative than the rate-based overfishing levels, given the current resource conditions.

A number of biological reference points and harvest policies have been proposed for management of EEZ populations of surfclams and ocean quahogs. The Council's harvest policy has been erroneously called a mining policy, in which the resource is fished to extinction over some finite planning horizon (Rago 1998). In reality the policy is a risk-averse adaptive strategy that computes a harvest rate based on current estimates of population biomass and an assumed level of recruitment to the population. The most conservative assumption, that recruitment is zero, implies the lowest harvest rate. Harvest levels are recomputed each year using the predicted population size as the measure of abundance. Periodic surveys of the resource are used to update abundance levels, thereby allowing revision of harvest levels in response to actual resource conditions. At SARC 26 (NEFSC 1998a), surfclam harvest levels were recommended to be set so as to maintain current population biomass. This policy recommendation seeks to preserve current resource levels by allowing harvest of projected biological production (Rago 1998).

The SARC 26 (NEFSC 1998a) did not have as a "term of reference" the development of an overfishing definition for surfclams because the final SFA guidelines were not available in December 1997. SARC 27 (NEFSC 1998b) did have as a "term of reference" the development of overfishing definitions for both surfclams and ocean quahogs, however members of SARC 27 felt that they could not constructively comment on surfclam overfishing definitions because they had not reviewed surfclam information. The SARC 27 concluded that: "No new information is available since SAW-26, at which time the SARC recommended that the catch associated with net production would maintain the population in the area(s) being fished."

With the need for a new overfishing definition to meet the SFA requirements for this Amendment, Council staff worked with several NEFSC scientists to develop the following approach for surfclams. It is important to remember that the recent SARCs declared that surfclams are"probably under-exploited overall" and ocean quahogs "would be considered under-exploited at the scale of the management unit".

Estimation of MSY requires an estimate of B_{MSY}, the stock biomass that will produce MSY. Due to data limitations for surfclams involving temporal changes in survey dredge catchability as well as lack of information on the relation between productivity and stock biomass, it is not feasible to get an analytic estimate of B_{MSY} from application of quantitative fisheries models. Furthermore, the dominant factor that controlled the size and structure of this stock in the last two decades was the hypoxic event of 1976, which caused mass mortality of surfclams and surfclam predators. Year classes and resulting stock biomasses that occurred after that event were likely atypical of what could be sustained by the resource in the long-term. The current surfclam fishery has been based on harvesting the cohorts that recruited throughout the 1980's and 1990's. A hypoxic event of similar magnitude could occur again in the future, but it can neither be predicted nor controlled. Thus, it is reasonable to base management decisions for this species on the current state of the stock and recent trends in fishery performance.

Several lines of evidence suggest that the 1997 biomass estimate for Northern New Jersey (NNJ) is a reasonable proxy for B_{MSY} , and that the annual production from that region is a reasonable proxy for MSY. These include:

- Annual production of biomass by surfclams in the NNJ region, where 80% of the landings are typically taken, is roughly equivalent to the annual EEZ quota.

- About 80% of commercial EEZ landings are typically taken from the NNJ region. While being exploited, mean shell length in this region has remained stable since 1985.

- Landings per unit effort (LPUE) by large vessels in the NNJ region have declined slightly since 1991, but have remained stable for the last four years (1994-97) at 1,650 - 1, 750 pounds of meat/hr fished.

- Annual recruitment has occurred repeatedly in the NNJ region where the fishery has been prosecuted. This is reflected by the large number of year classes in the stock in 1997.

These lines of evidence suggest that present harvests from this region are sustainable, at least for the next few years. It is not known, however, whether this is the maximum harvest that could be realized.

The critical aspect of the overfishing definition is that it is sustainable for several more years which will allow NEFSC to conduct more clam surveys (1999 and 2001) and thus will provide at least two more assessments that are as thorough as those produced from the 1997 survey. New survey technology and assessment approaches (NEFSC 1998a and 1998b) provided state-of-the-art analyzes, however these changes precluded direct comparisons with previous surveys. From the latest SARC (NEFSC 1998a) surfclams are "probably under-exploited overall", and thus there is practically no threat of overfishing in the immediate future.

Finally the "proxy" nature of using Northern New Jersey needs to be emphasized. The definition uses the best science from the most recent surfclam assessment, but as new assessment information becomes available (after the 1999 and 2001 surveys), any better information will be used, and in fact, it is seriously desired that true B_{msy} and F_{msy} estimates can replace the proxy, and thus should not require an Amendment. However, if an Amendment is necessary the entire overfishing definition is frameworked and thus could quickly be changed without major impact to industry or the resource.

Current biological reference points for Atlantic surfclam are $F_{max} = 0.21$, $F_{20\%} = 0.18$, $F_{0.1} = 0.07$ and $F_{PO} = 0.05$. F_{PO} is the fishing mortality rate in the NNJ region that would result from an annual catch equal to the annual production of biomass by that region. F_{PO} is recommended as an overfishing target, and the other biological reference points represent options for overfishing thresholds. All of the reference point estimates are sensitive to the value for natural mortality, M, which was assumed = 0.05. There is considerable uncertainty as to the true value of this parameter. If true $M > 0.05$, then both annual biomass production and F_{PO} are overestimated. Table 1 lists the most recent estimates from SARC-26 (NEFSC 1998a) of surfclam biomass, landings, F and production, by region and across regions. The most recent estimate of F for the NNJ region was 0.04, which is just below F_{PO} .

Exploitation rates in other areas are typically lower than the production rates and population status differs markedly across regions. Production rates tend to be lower in the Delmarva region where dense populations of slower growing individuals have accumulated in the absence of high fishing mortality. In contrast, unfished populations on Georges Bank appear to be accruing biomass each year. Owing to a large difference in primary productivity between these regions, it is not possible to derive simply an empirical biomass dynamics model. Intensive monitoring of regional populations, particularly in response to changing harvest patterns, may be sufficient to elucidate the underlying MSY. Until then, prudent quotas set at levels near current landings should be sustainable and exhibit minor interannual variation.

In regions that are currently unfished, F_{PO} for each region could serve as a reasonable proxy for F_{MSY}. It should be noted, however, that biomass and production levels should not be pooled across regions or years to define a global B_{MSY} and global MSY, respectively. Surfclams are sessile and local overfishing would occur if landings equal to a global MSY were taken from a single region such as NNJ. The regions defined in Table 1 appear to be on the appropriate physical scale for population management. Thus, increases in yield might be achieved from certain regions as long as the yield did not exceed that region's annual production.

In summary, the data are insufficient to accurately estimate B_{MSY}, MSY or F_{MSY}. However, stable yields, absence of change in mean length, successful recruitment, and the rough equivalence of production in NNJ with harvests, imply that the current policy is at equilibrium with the resource and may be near the optimum. Finally, we note that there is consistency between the current recommendation and earlier modeling results by Murawski and Idoine (1989). Their simulation model of surfclams under exploitation, which incorporated numerous population parameters including variability in recruitment among years, indicated that a constant-catch policy of 45 to 55 million pounds/yr would achieve a balance between yield maximization, low interannual variation in yield, and risk-aversion.

As further justification of the sustainable nature of the resource with these harvest levels, the estimate of MSY in the original FMP was 2.9 million bu. (approximately 50 million pounds of shucked meats) over the range of the resource, which was based on commercial landings from 1960-1976 (MAFMC 1977). In Amendment 8 (MAFMC 1988) the MSY section concludes, after extensive modeling by the NEFSC, that: "In terms of the overall MSY, it appears that the previous estimate of 50 million lbs of shucked clam meats everywhere, is probably the best current estimate for the mid-Atlantic EEZ surfclam population."

In conclusion, the new overfishing definition "target" for surfclams will be the 1997 biomass estimate for Northern New Jersey (NNJ) as a reasonable proxy for B_{MSY} and the associated F_{PO} (production replacement) level of fishing mortality that would result from an annual catch equal to the annual production of biomass by that NNJ region. The overfishing definition "threshold" would be ½ the B_{MSY} proxy (as recommended by the Applegate *et al.* 1998 Overfishing Definition Review Panel report) with an $F_{20\%}$ level of fishing mortality that should never be exceeded. The $F_{20\%}$ MSP level is the threshold level recommended by the NEFSC for Amendment 9 (MAFMC 1996) and reviewed and approved by the MAFMC Scientific and Statistical Committee.

For MSY of ocean quahogs, it is generally assumed that MSY for harvested populations occurs at one-half the virgin biomass. The 1997 surveyed biomass estimate (roughly 3 billion pounds of meats) is at about 80% of the virgin biomass (roughly 4 billion pounds of meats) (Figure 8) and exploitation rates are below $F_{0.1}$, $F_{25\%}$, and F_{max}. The combination of current biomass and F is highly unlikely to represent overfishing, as defined by the current SFA guidelines (NEFSC 1998b). There is however, significant time to determine the exact nature of the sustainability of the resource, since total removals (which have averaged about 40 million pounds/year) over the past two decades have only reduced the virgin biomass by about 20%.

The current biomass is less than the likely carrying capacity (K) of the resource, but well above K/2. Moreover, the current fishing mortality rates are well below existing fishing mortality rate thresholds. Current status of the ocean quahog resource is schematically depicted in Figure 8. The 1997 surveyed biomass estimate (roughly 3 billion pounds of meats) is at about 80% of the virgin biomass (roughly 4 billion pounds of meats). This figure suggests that fishing mortality rates are below two alternative action levels and that overall population biomass exceeds levels which would require rebuilding. Nonetheless, 22 years of harvesting appear to have reduced the population in some areas. It is not yet possible to characterize the dynamic response of the population to these decreases in density. In many instances, the recruits that might have been produced as a result of prior reductions are only now becoming vulnerable to the survey dredge. Thus, some caution is necessary in the interpretation of Figure 8.

In conclusion, the overfishing definition "target" for ocean quahogs is one-half the virgin biomass and the $F_{0.1}$ level of fishing mortality for the exploited region. The overfishing definition "threshold" would be one-half B_{MSY} or one-quarter of the virgin biomass (as recommended by the Applegate *et al.* 1998 Overfishing Definition Review Panel report) with an $F_{25\%}$ level of fishing mortality that should never be exceeded. The $F_{25\%}$ MSP level is the threshold level recommended by the NEFSC for Amendment 9 (MAFMC 1996) and reviewed and approved by the MAFMC Scientific and Statistical Committee.

2.1.5 Probable Future Condition

Surfclam Management Advice from SARC 26 (NEFSC 1998a): There appears to be little scope for increased catches in NNJ, given that the fishery now occurs over the entire range of the NNJ portion of the stock, and catch approximately equals production. The fishery could be expanded in the Delmarva area, since that is the one area in the Mid-Atlantic which has significant annual net production. Careful consideration needs to be given to implementing stock-wide quota increases because the additional catch would likely be taken in the NNJ area to the detriment of that fishery. There is substantial net production on Georges Bank which is capable of supporting a fishery.

Surfclams in the Delmarva region are now growing slowly, have low meat weights, and may be stunted. It is unclear to what degree this is due to density dependence or environmental effects. Therefore, it is unclear whether reducing the density through fishing would improve growth and condition.

As stated in the SARC/SAW-22 Consensus Summary, this is *"an appropriate time for the Council to revisit the question of appropriate harvest policies for the surfclam"*. The 10-year harvest policy recently used for determining quotas for the surfclam fishery was predicated on a mining strategy and the assumption that strong recruitment events occurred at decadal intervals. The policy was initially intended to assure constant harvests in the interval between large recruitments. It is now clear that moderate levels of surfclam recruitment occurred annually over the past two decades (Figure 5), and these recruitments have supported a sustainable fishery. The SARC recommends that the Council consider developing new harvest policy guidelines which meet its objectives of relatively stable catches and catch rates (LPUE) and which prevent overfishing. In the interim, the SARC recommends that harvest levels be set no greater than the annual biomass production from the resource.

Surfclam Forecasts from SARC 26 (NEFSC 1998a): 1) Production Model. A model of total biomass production and harvesting in the various assessment areas was developed based on annual biomass production from survey-based estimates. Annual production (biomass gain from individual growth) minus losses (natural mortality, landings, and unobserved fishing mortalities) was estimated for each area based on survey size compositions, length-weight parameters, growth equations (in shell length), swept-area population estimates from surveys, and natural mortality rates. Effects of uncertainty about dredge efficiency and natural mortality were evaluated.

If natural mortality (M) is assumed to be 0.05, then under current harvest patterns, total biomass off Delmarva (DMV) and Southern Virginia (SVA) will increase during the next year by about 26.5 million pounds and 8.8 million pounds, respectively. In the other Mid-Atlantic areas (e.g., Northern and Southern New Jersey), total biomass will likely not change substantially. On Georges Bank, total biomass may increase by about 66 million pounds, but some of this may not be fishable because of rocky substrate. These forecasts are sensitive to the assumed value of M.

2) 10-Year Supply Model. In SAW-22, a "10-year supply" model was used to project full-recruit population size, catch, and exploitation rate. The model makes assumptions about levels of natural mortality (M), recruitment, and growth. It computes the annual catch that could be taken for 10 years, after which time population size would be zero. This calculation is updated on an annual basis, so population size does not actually equal zero after 10 years.

Results from this model are given for three spatial scales and three levels of M. For all runs and levels of M, catches for 1999, corresponding to the 10-yr supply, are well above those given in SAW-22. The increase is the result of using a revised estimate of initial full-recruit biomass which is much larger than that estimated for SAW-22. Exploitation rates associated with these catches would exceed the current overfishing level (at $F_{20\%}$, U = 16.1%; SAW-22) in the areas being exploited. However, when all areas are included, the exploitation rate would be reduced to approximately 12%, which is below the present overfishing definition.

Ocean Quahog Management Advice from SARC 27 (NEFSC 1998b): A revised biomass estimate for 1997 indicates that current catch quotas are consistent with a supply policy of 54-76 years, which is substantially more conservative than the present 30-year policy. Quotas consistent with the 30-year policy would be about 80 million pounds for 1999 and about 78 million pounds for 2000, under the assumption of a survey dredge efficiency of 0.43. However, local declines may occur if the fishery concentrates in certain locations with high biomass. Given the past performance of this fishery, effort is directed away from areas as soon as CPUE declines by 30-40%, so the number of areas profitable for harvesting may become limiting years before the stock undergoes a major decline in biomass.

The current definition of overfishing at the scale of the management unit does not take into account the sedentary nature of ocean quahogs and the ability of the fleet to fish down local aggregations. It is currently unknown if the quahog densities left on the ground after the beds have been fished down are sufficient to ensure successful fertilization. There is, therefore, a clear need to gain information on reproduction and population dynamics (recruitment, growth, and natural mortality) and consider spatially-explicit management policies. It would be precautionary to implement closures within certain fishing areas as a further measure of protection. This should be linked with research on the effects of closures.

Ocean Quahog Forecasts from SARC 27 (NEFSC 1998b): 1)*Supply-Year Model*. This model computes the annual catch that could be taken for *n* years, after which population size would be zero. This calculation is updated on an annual basis, so population size does not actually equal zero after *n* years. Therefore, it is more accurate to call this a "planning horizon" model in which harvest rates are continuously adjusted such that the population will always last for the duration of the planning horizon. The model makes assumptions about levels of natural mortality (M), recruitment, and growth.

Results are given for four supply-year policies ranging from $n = 30$ to 76 years. The 30-year planning horizon represents the historical MAFMC policy for quota setting. The 54-, 63-, and 76-year policies represent 1999 catches of 50, 45, and 40 million pounds, respectively, which are in the range of recent annual harvests. According to the model, the starting biomass in the year 2000 would be at least 92% of the 1997 biomass estimate for all of these policies. For the 30-year policy, exploitation rates in 1999 and 2000 range from 3.9 to 4.0% in the exploited area, and equal 2.7% for the total surveyed stock. The longer supply-year policies are more conservative. All exploitation rates in Table 2 are at or below the F-based reference points for this species (Figure 8).

Model results are based on the following inputs: the exploited region is SNE-DMV; stock biomass includes all sizes, assuming a dredge efficiency of 0.43 and unrevised length/weight equations; GBK is unexploited and is 30% of initial stock biomass; annual recruitment by pre-recruits is 24 million pounds/yr in the exploited region and 10 million pounds/yr in the unexploited region, M = 0.02; instantaneous growth (g) rate of full recruits is 0.0076 per year; the 1998 catch is assumed to be 40 million pounds, the EEZ quota (Table 3).

2) Production Model. A model of total biomass production and harvesting in the various assessment areas was developed based on annual biomass production from survey-based estimates. Annual production (biomass gain from individual growth) minus losses (natural mortality, landings, and unobserved fishing mortalities) was estimated for each area based on survey size compositions, revised length-weight parameters, growth equations (in shell length), swept-area population estimates from surveys, and natural mortality rates. The model was run using "original" and "augmented" size frequency distributions. The latter contain additional individuals in the small size classes to account for selectivity by the survey dredge.

Owing to the slow growth rate of this species and the dominance of large individuals in the survey samples, annual production is low even when revised length/weight equations are used. Given current harvest levels, the model results indicate losses of 1-3% per year in fished areas and a gain of 1-2% on unfished Georges Bank. For the entire stock, the annual change would be approximately -1% per year.

2.2 DESCRIPTION OF HABITAT

2.2.1 Habitat Requirements by Life History Stage

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

In section 600.815 (a)(2)(I)(B) in order to identify EFH, basic information is needed on current and historic stock size, the geographic range of the managed species, the habitat requirements by life history stage, and the distribution and characteristics of those habitats.

Surfclams are distributed in western North Atlantic waters from the southern Gulf of St. Lawrence to Cape Hatteras. Commercial concentrations are found primarily off New Jersey and the Delmarva Peninsula, although some fishable quantities exist in Southern New England waters, on Georges Bank, and off the Virginia Capes. In the Mid-Atlantic region, surfclams are found from the beach zone to a depth of about 200 feet, beyond about 125 feet, however, abundance is low.

The ocean quahog is a bivalve mollusk found in temperate and boreal waters on both sides of the North Atlantic. Distribution in the western Atlantic ranges from Newfoundland to Cape Hatteras in depths from 25 to 800 feet. Quahogs are rarely found where bottom water temperatures exceed 65 °F, and occur progressively further offshore between Cape Cod and Cape Hatteras.

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

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

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

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

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

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

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

The Regional Action Plan (USDC 1985a) process identified six water management units in the Northeast region (Figure 9). The boundaries of each water management unit (WMU) were established on the basis of the biogeographic consistency of the entire WMU and its distinctness from other WMUs. Each WMU is relatively consistent in its physical and chemical characteristics with normal latitudinal and seasonal variations in temperature, salinity, and nutrient content. The diverse biota in these WMUs include both endemic and migratory species that exhibit normal seasonal fluctuations in species composition, individual population size, and geographic distribution.

These six units are: Coastal Gulf of Maine, Gulf of Maine, Georges Bank West to Block Channel, Coastal Middle Atlantic, Middle Atlantic Shelf, and Offshelf (USDC 1985a).

The Coastal Gulf of Maine WMU encompasses an area bounded seaward by the observable limits of coastal processes, including riverine and estuarine plumes, coastal upwelling and diurnal tidal fluxes. Geographically, the area is bounded on the northeast by the Canadian Border and on the southwest by Cape Cod. This zone is generally marked by steep terrain and bathymetry, joining at a rock bound coastline with numerous isles, embayments, pocket beaches, and relatively small estuaries. Circulation is generally to the southwest along Stellwagen Bank, and finally offshore at Cape Cod. The habitats are presently affected by ocean disposal and effluents from major urban areas, along with significant non point source pollution associated with the various rivers. Continued pressure to fill already depleted marsh and shallow water areas occurs in most parts of the area (USDC 1985a).

The Gulf of Maine is a semi-enclosed sea of 55,000 square miles separated from the Atlantic Ocean by Browns and Georges Banks. It is an area of five major basins, floored with clays and gravelly silts, and broken by rocky outcroppings, numerous ledges and banks. The circulation is only generally understood: a seasonal clockwise gyre swings around the Gulf and joins the clockwise gyre on the northern edge of Georges Bank. Presently, threats to the area are from the coastal Gulf of Maine and from ships transiting the area (USDC 1985a).

The Georges Bank West to Block Channel WMU includes Georges Bank, The Great South Channel, and Nantucket Shoals. These areas have similar habitats, biota and hydrographic regimes. Overall, this WMU is highly productive and heavy fishing pressure is exerted on its numerous fish and shellfish. It is threatened by OCS exploratory drilling and by non point source pollution from atmospheric fallout, general circulation patterns, and marine transportation activities (USDC 1985a).

The Coastal Middle Atlantic WMU encompasses a zone from Cape Cod southwest to Cape Hatteras. The area is characterized by a series of sounds, broad estuaries, large river basins and barrier islands. The predominantly sand bottom is characterized by a ridge and swale topography. The waters of the Coastal Middle Atlantic have a complex and seasonally dependent pattern of circulation. Seasonally varying winds and irregularities in the coastline result in the formation of a complex system of local eddies and gyres. Currents tend to be strongest during the peak river discharge period in late spring and during periods of highest winds in the winter. In late summer, when winds are light and estuarine discharge is minimal, currents tend to be sluggish, and the water column is generally stratified. The Coastal Middle Atlantic provides major habitats for anadromous, estuarine, and endemic species. Migratory species play a major role in this WMU, and make up the predominant stocks in various seasons. Surfclams and ocean quahogs constitute the major benthic fauna. Estuaries provide major spawning and nursery areas for many of the endemic and migratory species. These species are presently affected by non point and point sources of pollution from major rivers and urban areas, as well as by direct loss of habitat caused by filling of wetlands, damming and diversion of rivers, and mosquito ditching in marshes (USDC 1985a).

The Middle Atlantic Shelf WMU covers the area from the Block Island Front southward to Cape Hatteras. The inshore boundary follows the observable limits of coastal processes, primarily estuarine plumes, and lies approximately 30 miles from the coast. This WMU generally is characterized as a sandy plain, with a ridge and swale topography. Numerous submarine canyons intersect this area. The surface circulation over the shelf can be divided into a two celled system, separated at the Hudson Valley. The subsurface and bottom circulation tends to flow in a westerly-southwesterly direction that varies with the passage of weather systems and offshore warm core rings. Hydrographic conditions vary seasonally from vernal freshening and warming, through summer stratification, to fall/winter breakdown and cooling. This WMU has a different faunal composition than the Gulf of Maine or Georges Bank. Fish populations are predominantly migratory, and species composition varies with season. Ocean quahogs are one of the major benthic organisms. It was threatened by OCS exploratory drilling; by non point source pollution from atmospheric fallout, general circulation patterns, and marine transportation activities; and by ocean disposal of sewage sludge and industrial wastes (USDC 1985a).

The Offshelf WMU encompasses the zone defined by the mean observable limits of the shelf-slope front seaward to the mean axis of the Gulf Stream. The area is overlain by the Slope Water Regime, a mass of relatively warm saline water having a generally weak circulation to the southwest. The upwelling area along the inner boundary of the shelf-slope front is high in productivity and rich in commercially valuable fish and shellfish. The general flow of the surface water layer between the Gulf Stream and the land is towards the south. Offshore, the Gulf Stream undulates as it moves to the northeast, forming a dynamic boundary from which warm core rings are borne. These rings spawned at a rate of about eight per year, are about 50 to 100 miles in diameter; they break off east of the area and transit to the southwest, eventually coming in contact with the shelf at southwestern Georges Bank. The passage of each ring marks a major event in the hydrographic regime and may significantly affect the biota of the shelf-slope front and possibly of the shelf itself. Other than ring passages, impacts on the offshelf waters are primarily from non point source pollution from atmospheric fall out, marine transportation, and from point source pollution from dumping at Deepwater Dumpsite 106 and ocean incineration (USDC 1985a).

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

2.2.1.1 Surfclam habitat and environmental inventory

The following information on historical stock size and geographic range (Figure 1) of the managed species, as well as habitat requirements and the distribution and abundance of eggs/larvae and juveniles/adults in sections 2.2.1.1.1 through 2.2.1.1.3 is taken directly from the EFH Source Document "Surfclam, *Spisula solidissima*, Life History and Habitat Requirements" (Weissberger *et al.* 1998a). This Weissberger *et al.* (1998a) document is referred to hereafter as the surfclam EFH background document. Most of the Tables and Figures from Weissberger *et al.* (1998a) are included in this FMP. This Weissberger *et al.* (1998a) surfclam EFH background document is currently being modified for publication by NMFS and can be obtained in its entirety from NMFS, Sandy Hook Laboratory, 74 McGruder Road, Highlands, New Jersey 07732.

2.2.1.1.1 Status of the stock

Total commercial landings of Atlantic surfclam peaked during 1973-75, with an average meat weight of 88 million lbs (Weinberg 1995). This was followed by a decline to an historical low of 35 million lbs by 1979 (Weinberg 1995). Landings increased to greater than 66 million lbs in 1984, and have remained at comparable levels ever since. Landings in 1996 were 63.5 million pounds, almost identical to 1995 and a 7% decrease from 1994 (Figure 10). Biomass indices from research vessel surveys generally parallel trends in landings. The results of the 1997 surveys indicate that the majority of the surfclam resource is concentrated in northern New Jersey, Delmarva, and Georges Bank (NEFSC 1998a).

The EEZ surfclam resource is currently at a medium level of biomass and appears under-exploited overall (NEFSC 1998a). The September 1997 report to Congress, *Status of Fisheries of the United States* (National Marine Fisheries Service 1997), states that the surfclam is presently not overfished, nor is it approaching an overfished condition.

2.2.1.1.2 Range

The surfclam is one of the largest bivalves in western North Atlantic continental shelf waters and is distributed from the southern Gulf of St. Lawrence to Cape Hatteras, NC (Merrill and Ropes 1969, Weinberg 1995). In U.S. waters, major concentrations of surfclams are found on Georges Bank, south of Cape Cod, off Long Island, southern New Jersey, and the Delmarva Peninsula (Merrill and Ropes 1969, Ropes 1978). Although surfclams can inhabit waters from the surf zone to a depth of about 400 feet, most are found at depths of less than 240 ft (Ropes 1978). Along Long Island and NJ, the highest concentrations have been found at depths less than 60 ft, and off Delmarva, the greatest concentrations occur at depths of 60 to 125 ft (Ropes 1978).

A southern subspecies, *Spisula solidissima similis*, occurs south of Cape Hatteras (Walker and Heffernan 1994). Another species, *Spisula raveneli*, occurs in the southern part of the range of *S. solidissima*. This species distinction, based on distribution and morphology (Porter and Schwartz 1981), is controversial (Vecchione and Griffis 1996).

Commercial concentrations are found primarily in sandy sediments off New Jersey and the Delmarva Peninsula (Figure 10), although some fishable quantities exist in southern New England waters and on Georges Bank (NEFSC 1998a).

The southern distribution of surfclams is limited by water temperatures of 73 °F (Saila and Pratt 1973). This fact becomes apparent when the depth distribution of adult clams is examined. Adults are found intertidally in New England, but no significant numbers are found inshore off the Delmarva Peninsula. The fishery started in New England; clams were harvested with hand equipment (Yancey and Welch 1968). No commercial beds are found inshore off Delmarva (Loesch and Ropes 1977) but commercial quantities are found 15 or more miles off the coast. This phenomenon is not from lack of recruitment inshore, because densities of spat as high as 1 - 2 million per mile were estimated in the intertidal zone of Wallops Island, Virginia (Yancey and Welch 1968). Mortality of these recruits were attributed to high water and air temperatures (Ropes and Merrill 1970).

2.2.1.1.3 Habitat requirements, distribution, and abundance by life history stage

An extensive review and synthesis of peer-reviewed literature provides information on the habitat requirements and preferences of Atlantic surfclams (Table 4). The review and synthesis concentrates primarily on beds in U.S. water; most information is from beds in the Middle Atlantic Bight. The results of the literature review by reference are presented in Appendix 3 of Weissberger *et al.* (1998a)

2.2.1.1.3.1 Eggs and larvae

Habitat requirements

Fertilized eggs develop into pyramid-shaped, planktonic trochophore larvae in approximately 9 hours after fertilization at 71 °F (21.7 °C; Ropes 1980) and 40 hours at 57 °F (Loosanoff and Davis 1963). Veliger larvae, the first larval stage to possess a bivalved shell, appear in 72 hours at 57 °F and 28 hours at 72 °F (Loosanoff and Davis 1963). The pediveliger stage, a transitional "swimming-crawling" larval stage with development of a foot for burrowing (Fay *et al.* 1983), is first observed 18 days after fertilization at 71 °F (Ropes 1980). Metamorphosis to juveniles, which consists of complete absorption of the velum and settlement to the substrate, is first observed anywhere from 19 to 35 days after fertilization, depending on temperature (Fay *et al.* 1983). Size at metamorphosis is approximately 0.009 inches in shell length; Ropes (1980) noted that larvae metamorphosed at a larger size, 0.01 inches.

The optimum temperature for larvae is 71 °F, and they are able to tolerate temperatures ranging from 57-84 °F (Fay *et al.* 1983). High temperatures can be lethal to developing larvae. Substantial mortality occurred in early cleavage stages exposed to 85 °F water for 10 minutes, in trochophores exposed to 89 °F water for 1 hour, and in straight-hinge veligers exposed to 93 °F for 3 hours (Roosenberg *et al.* 1984). Larvae are capable of growing in salinities as low as 16 ppt and can survive in salinities of 8 ppt at 46 °F (Yancey and Welch 1968). In the laboratory, larvae did not cross salinity discontinuities greater than 15 ppt, and in a salinity gradient remained in high-salinity water (Mann *et al.* 1991).

Distribution and abundance
Very few studies have examined surfclam larvae in the field. In New England, Mann (1985) reported high larval concentrations, up to 23 larvae/ft^3 associated with 57-64 °F water masses and relatively low chlorophyll *a* concentrations. Spring larvae in New Jersey are often derived from inshore clams, while fall larvae were from offshore clams. Dispersal by currents occurs during the larval stage (Fay *et al.* 1983) and there is some suggestion that larval settlement may coincide with the relaxation of upwelling events. Franz (1976) hypothesized that a convergence of tidal and longshore currents trap surfclam larvae off western Long Island, although this theory is based on juvenile and adult distributions rather than larval samples.

Eggs and larvae are not enumerated by the NEFSC MARMAP program.

2.2.1.1.3.2 Juveniles and adults

Habitat requirements
The size and age of sexual maturity is variable. Off New Jersey, surfclams may reach maturity as early as 3 months after settlement and at lengths of less than 0.2 inches (Chintala and Grassle 1995, Chintala 1997). At the other extreme, clams from Prince Edward Island, Canada, may not reach maturity until 4 years of age and 3.2-3.7 inches shell length (Sephton 1987, Sephton and Bryan 1990). In Virginia, the minimum length at maturity was 1.8 inches, and size, rather than age, was more important in determining sexual maturity (Ropes 1979). Because of this wide variability in age at maturity, juveniles and adults will be discussed together.

Surfclams may reach a maximum size of 9 inches (Ropes 1980), and a maximum age of 31 years (Jones *et al.* 1978). Growth appears to be similar among different localities during the first 3-5 years of life (Ambrose *et al.* 1980, Sephton and Bryan 1990), but after the first five years, offshore clams grow faster and attain a larger maximum size than inshore clams (Jones *et al.* 1978, Jones 1980, Ambrose *et al.* 1980, Wagner 1984). High clam density may negatively affect growth rate and maximum size (Cerrato and Keith 1992, Fogarty and Murawski 1986); density effects on growth have been detected at relatively low densities (less than 50 clams per 3788 ft^2 ; Weinberg 1998). Growth lines in surfclams are deposited at times of spawning and high temperature, but there is some question as to whether lines are annual (Jones *et al.* 1978, Jones 1980, Wagner 1984, Walker and Heffernan 1994).

Surfclams are susceptible to low levels of dissolved oxygen. Severe hypoxic events (dissolved oxygen less than 3 ppm) in New Jersey have killed surfclams several times (Ogren and Chess 1969, Garlo *et al.* 1979, Ropes *et al.* 1979). Weinberg and Helser (1996) showed spatial and temporal changes in growth rate and maximum size and hypothesized these changes may be related to low dissolved oxygen levels. Positive effects of hypoxia include the decimation of surfclam predators, allowing successful recruitment of recently-settled clams (Garlo 1982). In the laboratory, Thurberg and Goodlett (1979) noted that a dissolved oxygen level less than 1.4 ppt was nearly always fatal, although clams could survive at levels as low as 0.7 ppt if acclimated slowly. Surfclam heart rate remained relatively constant over a wide rage of oxygen concentrations (deFur and Mangum 1979).

Supersaturation of oxygen may also negatively affect clams. In the laboratory, significant surfclam mortality occurred at 114% oxygen saturation (Goldberg 1978). Sublethal effects at lower oxygen levels included tissue blisters and secretion of shell material surrounding air bubbles.

There has been little work on the effects of currents on surfclams, particularly on feeding and bedload transport of small clams. The dynamic environments in which surfclams live may substantially affect flux of food and population distribution. For example, oceanic storms can displace adults a considerable distance from their burrows (Fay *et al.* 1983).

Distribution, Abundance, and density
In the field, the greatest concentrations of surfclams are usually found in well-sorted medium sand (Dames and Moore 1993), but they may also be found in fine sand (MacKenzie *et al.* 1985) and silty-fine sand (Meyer *et al.* 1981). Ambrose *et al.* (1980) noted a positive correlation between growth rate and mean sediment grain size when other variables were controlled. On the other hand, Goldberg and Walker (1990) found that substrate type did not affect growth rate of clams in the laboratory and field, although clams did not burrow in mud.

NEFSC surveys captured surfclams from Georges Bank to Cape Hatteras (Figure 1). The greatest number of catches were made from Hudson Canyon to Cape Hatteras inshore of the 200 ft contour. The Gulf of Maine was not surveyed, although surfclams can be found in areas containing suitable (sand) substrate.

2.2.1.2 Ocean quahog habitat and environmental inventory

The following information on historical stock size and geographic range of the managed species, as well as habitat requirements and the distribution and abundance of eggs/larvae, juveniles, and adults in sections 2.2.1.2.1 through 2.2.1.2.3 is taken directly from the EFH Source Document "Ocean Quahog *Arctica islandica*, Life History and Habitat Requirements" (Weissberger *et al.* 1998b). This Weissberger *et al.* (1998b) document is referred to hereafter as the ocean quahog EFH background document. Most of the Tables and Figures from Weissberger *et al.* (1998b) are included in this FMP. This Weissberger *et al.* (1998b) ocean quahog EFH background document is currently being modified for publication by NMFS and can be obtained in its entirety from NMFS, Sandy Hook Laboratory, 74 McGruder Road, Highlands, New Jersey 07732.

2.2.1.2.1 Status of the stock

Total commercial ocean quahog landings increased dramatically between 1976 and 1979, from 5.5 million pounds to 35 million pounds, and rose to more than 44 million pounds by 1985 (Weinberg 1995). Landings have remained high ever since (NEFSC 1998b). Landings in 1996 were 48 million pounds, a 3% decrease from 1995.

The September 1997 report to Congress, 'Status of Fisheries of the United States' (National Marine Fisheries Service 1997), states that the ocean quahog is not overfished at the present time, nor is it approaching an overfished condition.

2.2.1.2.2 Range

The ocean quahog is distributed on the continental shelf from Newfoundland to Cape Hatteras (Weinberg 1995). Distribution ranges from Newfoundland to Cape Hatteras in depths from 25 ft to 800 ft in the western Atlantic. Quahogs are rarely found when bottom water temperatures exceed 60 °F and thus occur progressively further offshore between Cape Cod and Cape Hatteras. Highest densities in the mid-Atlantic region are between 130 ft and 200 ft; few quahogs have been found in the mid-Atlantic in excess of 300 ft. Medcof (1958) has reported large stocks in the Southern Gulf of St. Lawrence; other major areas of concentrations have been reported along the coasts of Scandinavia, Greenland, and Newfoundland (Parker and McRae 1970). Ocean quahogs are probably present on much, if not most, of the continental shelf of North America.

Greatest concentrations are in offshore waters south of Nantucket to the Delmarva Peninsula (Serchuk *et al.* 1982). The inshore limit of their distribution appears to be limited by the 61 °F bottom isotherm in the summer months (Mann 1989). Although the species has been found at depths of 46-270 ft, most are found at depths of 82-200 ft (Merrill and Ropes 1969, Serchuk *et al.* 1982) and some have been found as deep as 840 ft (Ropes 1978). They are found in relatively shallow water in eastern Maine (but never intertidally) and in deeper, more offshore waters south of Cape Cod (MAFMC 1998).

2.2.1.2.3 Habitat requirements by life history stage

An extensive review and synthesis of peer-reviewed literature provides information on the habitat requirements and preferences of ocean quahogs (Table 5). The review and synthesis concentrates primarily on U.S. stocks; most information from north of the Gulf of Maine was not considered. The results of the literature review by reference are presented in Appendix 3.

2.2.1.2.3.1 Eggs/Larvae

Habitat requirements
The eggs and larvae of ocean quahogs are planktonic, drifting with currents until the larvae metamorphose into juveniles and settle to the bottom (MAFMC 1998). Eggs range in size from 80-95 μm in diameter (Loosanoff 1953). Larvae are planktotrophic, and have been reared on unicellular algae in the lab (Landers 1976, Lutz *et al.* 1981 and 1982). Mann (1985) reports the range of algal concentrations (0.32-0.41 x 10^4 cells/in^3; 5.4 x 10^2 to 6.77 x 10^4 cells/ml) at a New England site to be sufficient for larval growth.

The minimum larval development period of ocean quahogs is 55 days at 47-50 °F (Lutz *et al.* 1981 and 1982), 60 days at 50-54 °F (Landers 1972 and 1976), and 32 days at 55 °F (Lutz *et al.* 1981 and 1982). There is some variation in the reported length at metamorphosis, from 0.007-0.008 inches (Landers 1972, 1976) to 0.009 inches (Lutz *et al.* 1981 and 1982).

Mann and Wolf (1983) studied larval behavior in the laboratory. Trochophores were negatively geotactic (i.e. tend to move up in the water column), showed no phototaxis (i.e. did not orient themselves toward light), and showed no change in swimming behavior when water pressure was changed from 1-3 atm. Veligers also showed no phototaxis; veligers 0.006-0.007 inches long moved upward with an increase in pressure and downward with a decrease in pressure, but larger veligers showed no response to pressure change.

Distribution and abundance
Little is known about the distribution or abundance of ocean quahog larvae in the field. Mann (1985) noted quahog larvae in southern New England waters in May (3-100 ft depth) and from July to November (66-131 ft depth). The highest larval concentration was 15 larvae/ft^3 in September at 100 ft depth. High larval concentrations were associated with temperatures of 57-64°F. The presence of larvae in May suggests that larvae may survive over the winter. Larval settlement is believed to occur throughout the adult distribution range (Mann 1989).

Eggs and larvae are not enumerated by the NEFSC MARMAP program.

2.2.1.2.3.2 Juveniles

Habitat requirements
Juvenile ocean quahogs are found offshore in sandy substrates (Kraus *et al.* 1989 and 1992) but may survive in muddy intertidal environments if protected from predators (Kraus *et al.* 1991). Recruitment of juveniles into the population is relatively low. The protracted spawning period suggests that recruitment may occur at low levels over several months, rather than in a single strong pulse. Kennish and Lutz (1995) attribute low recruitment to adverse environmental factors (poor substrate, high temperatures) and predation on recently-settled individuals.

Growth is relatively fast during the juvenile stage. In a 3-year laboratory study, Lutz *et al.* (1982) found that quahog length ranged from 0.04-0.15 inches, 7.5 months after metamorphosis. Kraus *et al.* (1989 and 1992) report a laboratory growth rate of 0.72 in./year for the first two years of life, and 0.28 in./year for the third year. In a one-year field caging study, Kennish *et al.* (1994) found that quahogs 0.36-0.76 inch shell length grew an average of 0.39-0.87 in./year.

Ocean quahogs mature very slowly. Rowell *et al.* (1990) report the mean age of sexual maturity for Nova Scotia quahogs to be 13.1 years for males and 12.5 years for females; the earliest age of maturity was 7 years for both sexes. Maturity occurred at about 1.9 inch shell length. Ropes *et al.* (1984) found that immature clams off Long Island were 2-8 years old, and 0.74-1.8 inches long. Thompson *et al.* (1980) reported the average age of maturity for the Middle Atlantic Bight quahogs was 9.38 years, but that this was extremely variable.

Distribution and abundance
NEFSC surveys captured ocean quahogs from Georges Bank to Cape Henry, VA (Figures 11). The greatest number of catches were made from Long Island to the Delmarva Peninsula. They occur further offshore south of the Hudson Canyon. The distribution of juveniles and adults appear to be the same. However, juveniles are not sampled well by the survey gear. Thus, Figure 11b may not accurately reflect actual juvenile distribution. The Gulf of Maine was not surveyed; however, quahogs tend to be found in fishable concentrations in relatively nearshore waters of the Gulf (Weinberg 1995). The MAFMC (1998) Amendment 10 provided management measures for the small artisanal fishery for ocean quahogs off the northeast coast of Maine.

2.2.1.2.3.3 Adults

Habitat requirements
The ocean quahog is among the longest-lived and slowest growing of marine bivalves and may reach a maximum age of 225 years (Ropes and Murawski 1983). They grow very slowly or not at all and individuals of similar size may vary greatly in age. Quahogs off Long Island grew 0.02 in./year in 1970 and 0.05 in./year in 1980, while those off New Jersey grew an average of 0.04 in. in 1.6 years. In Whitsand Bay, UK, quahogs grew 0-0.06 in./year (Kennish *et al.* 1994, Kennish and Lutz 1995). Ocean quahogs from Georges Bank appear to be the youngest (Ropes and Pyoas 1982), suggesting that conditions there are favorable for quahog growth. Growth rates may be reduced at high density. Beal and Kraus (1989) noted that growth was reduced by a factor of 1.2 when density was increased from 30-60 clams/ft^2. Growth is also dependent upon temperature. Stable isotopes show a consistent growth shutdown temperature of about 43°F for a clam from Nantucket Shoals, implying a May-December growing period (Weidman and Jones 1993).

Ocean quahogs are capable of surviving low dissolved oxygen levels. In both the laboratory and field, quahogs can burrow in the sand and respire anaerobically for up to seven days (Taylor 1976). Declining O_2 tension results in increased rate of ventilation, reduced O_2 utilization, and heart rate changes (Taylor and Brand 1975). Under anoxic conditions, enzymes are modified to reduce metabolism and energy release (Oeschger 1990, Oeschger and Storey 1993). Quahogs may also undergo self-induced anaerobiosis (Oeschger 1990). Even with the ability to survive hypoxic conditions, ocean quahogs may still experience negative effects of low oxygen levels. During a hypoxic event off New Jersey in 1976, up to 13.3% of ocean quahogs died in the shoreward part of the population. However, quahogs in deeper water were not subjected to hypoxia (Ropes *et al.* 1979).

Ocean quahogs are suspension feeders on phytoplankton, pumping in water using their relatively short siphons which are extended above the surface of the substrate. In the laboratory, Winter (1969) showed that the maximum rate of algal filtration occurred at 68 °F and 0.82 x 10 cells/in^3, but such high algal concentrations are unlikely to occur in the field. Extremely high algal concentrations may interfere with feeding (Winter 1970). In 24 hours, two feeding periods alternate with two digestion periods (Winter 1970).

Distribution, abundance, and density
Adult ocean quahogs are usually found in dense beds over level bottoms, just below the surface of the sediment which ranges from medium to fine grain sand (Medcof and Caddy 1971, Beal and Kraus 1989, Fogarty 1981). Based on field distributions on both sides of the Atlantic, Golikov and Scarlato (1973) estimated the optimal temperature for ocean quahogs to be 45-61 °F. Mann (1989) reports the inshore limit of quahog distribution as the 61 °F bottom isotherm in summer months. Merrill *et al.* (1969) report a lethal temperature of above 61 °F; quahogs held at 70 °F died in a few days. Ocean quahogs are found at oceanic salinities, but Oeschger and Storey (1993) successfully kept them at 22 ppt in the lab for several weeks.

NEFSC surveys captured ocean quahogs from Georges Bank to Cape Henry, VA (Figures 11a-b). The greatest number of catches were made from Long Island to the Delmarva Peninsula. They occur further offshore south of the Hudson Canyon. The distribution of juveniles and adults appear to be the same. However, juveniles are not sampled well by the survey gear. Thus, Figure 11b may not accurately reflect actual juvenile distribution. The Gulf of Maine was not surveyed; however, quahogs tend to be found in fishable concentrations in relatively nearshore waters of the Gulf (Weinberg 1995). The MAFMC (1998) Amendment 10 provided management measures for the small artisanal fishery for ocean quahogs off the northeast coast of Maine.

2.2.1.3 Importance of surfclams and ocean quahogs in state waters

The Council, attempting to coordinate and obtain the best information available, requested each State from North Carolina to Maine to identify the critical surfclam and ocean quahog habitat under their jurisdiction. The following paragraphs are paraphrased from the responses of the States' surfclam and ocean quahog experts.

Virginia indicates that although they have some patchy distribution of surfclams within the State's three mile limit, there are no harvestable populations of surfclams or ocean quahogs (DiCosimo pers. comm.); therefore it is assumed that they have no essential habitat for these two species.

Maryland has no essential habitat for surfclams or ocean quahogs (Jensen pers. comm.).

Delaware (Cole pers. comm.) believes that the entire Delaware Territorial Sea, extending from the mouth of the Bay to the Delaware/Maryland line and out three nautical miles contains suitable habitat that once supported commercial densities of surfclams.

There is no evidence that these two species of clams are extant in Pennsylvania waters (Miller pers. comm.). This would be expected with basically fresh water salinity profiles.

New Jersey has no essential habitat for ocean quahogs within the territorial waters of their State (Cookingham pers. comm.). The entire New Jersey coast from Cape May to Sandy Hook and from the beach to three miles offshore encompasses New Jersey's surfclam habitat and all of this is considered essential habitat.

New York would like to consider all waters of the Atlantic Ocean and Long Island Sound under New York State control as essential habitat for both surfclams and ocean quahogs (Fox pers. comm.). Active food fisheries do exist in parts of these waters, and the uncertified westernmost areas support an important seasonal harvest for bait purposes. The more eastern areas, while not presently supporting significant harvests, do contain some surfclams and ocean quahogs, and thus represent areas of potential harvest in the event a set should occur and recruit into the fishery.

A recent inventory of shellfish populations in Connecticut waters of Long Island Sound identified low to moderate densities of surfclams at several sampling locations (Gunn pers. comm.). The ocean quahog is not found in Long Island Sound but does occur in large concentrations in Rhode Island and Block Island Sounds. Gunn (pers. comm.) did not specify any Connecticut waters as being critical to surfclams or ocean quahogs.

Rhode Island has extensive inshore concentrations of surfclams within the Harbor of Refuge, Sakonnet River and along the south shore beaches (Borden pers. comm.). Concentrations of ocean quahogs were identified by Fogarty (1981). Surfclams or ocean quahogs were found at all sample stations within the territorial waters of Rhode Island and therefore, those areas are considered critical habitat areas (Borden pers. comm.).

Massachusetts identified (Howe pers. comm.) that ocean quahogs are now found in relative abundance from Gay Head, Martha's Vineyard along the south shore of the island out into the EEZ. They are also found in abundance in two separate areas in the southern and southwestern reaches of Cape Cod Bay below the 60 foot contour. Ocean quahogs are also present within a deep-water rectangular block extending from off Boston north to New Hampshire off Cape Ann but are not now abundant enough to be commercially viable. Surfclam beds extend from Westport (Horseneck Beach) westward into lower Vineyard Sound, and are found in a narrow strip along the south shore of Cape Cod from Bass Rip to Point Rip. They are also abundant in Muskegut Channel and in territorial waters all around the backside of Nantucket Island. North of Cape Cod, surfclam beds extend from Hew Hampshire to Ipswich Bay, and from Hull south along the shore of Cape Cod Bay to Provincetown. The greatest concentrations in the Bay are from Dennis to Provincetown.

New Hampshire has limited surfclam and ocean quahog habitat with a small commercial surfclam fishery (Spurr pers. comm.). No essential habitat is presently identified.

Maine did not respond.

Currently, there are no other data available on surfclam and ocean quahog habitat in state waters. NOAA's estuarine living marine resources (ELMR) program does not include data on surfclams and ocean quahogs.

2.2.2 Description and Identification of Essential Fish Habitat

2.2.2.1 Methodology for description and identification

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

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

Matrices of habitat parameters (i.e. temperature, salinity, light, etc.) for eggs/larvae and juveniles/adults were developed in the surfclam and ocean quahog EFH background documents and included in this FMP as Tables 4 and 5. Currently, there are no state data available on surfclams and ocean quahogs. Due to the strict time constraints of the October-Sustainable Fishery Act deadline, it is unlikely that all the state data will be incorporated in this Amendment. However, as these and other data and information become available on surfclams and ocean quahogs, EFH designations can be reconsidered; and in fact, every FMP must be reviewed at least every five years. It is important to understand that this EFH is a "work in progress", and that the process will evolve. The identification and description of EFH is a frameworked management provision (section 2.2.8 for process description).

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

In section 600.815 (a)(2)(ii)(A) the Councils are given direction that they should "interpret this information in a risk-averse fashion". In the next section, (B) it states "if a species is overfished, and habitat loss or degradation may be contributing to the species being identified as overfished, all habitats currently used by the species should be considered essential in addition to certain historic habitats that are necessary to support rebuilding the fishery and for which restoration is technologically and economically feasible." Both surfclams and ocean quahogs are not presently overfished, and in fact are actually considered under-utilized in the recent stock assessments. Since both animals are benthic, the Council took a risk-averse approach because the animals can not move out of harms way.

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

Currently, one data set is available for determining surfclam and ocean quahog EFH. This data set, the NEFSC Atlantic surfclam and ocean quahog dredge survey is Level 2 data. Currently, there are no state data available to the NEFSC scientists at Sandy Hook in a consistent electronic format within NMFS for surfclams and ocean quahogs. The NEFSC clam dredge survey consistently sampled only areas between Georges Bank and Cape Hatteras, NC.

To identify and describe EFH offshore, the Mid-Atlantic Council is relying on data and information derived from the NEFSC dredge survey. This survey provides the best available information on the distribution and relative abundance of these Council-managed bivalves in offshore waters. Precise information on the distribution and relative abundance in inshore areas, especially in estuaries and embayments, is non-existent in most cases.

The Council is currently not identifying and describing EFH in state waters, because these waters are not included in the management unit. The management unit is all surfclams and ocean quahogs in the Atlantic EEZ. However, the Council does believe that important surfclam and ocean quahog habitat exists in state waters, and is specifically soliciting comments on whether EFH should be designated for inside the EEZ, as well as north of Georges Bank and south of Cape Hatteras.

Reid *et al.* produced an appendix to be used with all the species' habitat background documents produced by Sandy Hook Laboratory. This document describes the methods used in NEFSC Atlantic surfclam and ocean quahog dredge survey.

The NEFSC ran the MARMAP (Marine Resources Monitoring, Assessment and Prediction) program that sampled fish eggs and larvae on monthly to bimonthly surveys covering the continental shelf form Cape Hatteras, NC to Cape Sable, Nova Scotia from 1977 through 1987 (Cross 1998). A total of 81 surveys were made, and Reid *et al.* documents all the dates and numbers of tows for each survey where eggs and larvae were collected. This survey did not enumerate eggs and larvae of surfclams and ocean quahogs.

The NEFSC Atlantic surfclam and ocean quahog dredge survey was conducted intermittently from 1965 through 1997, with a total of 23 surveys. This survey is designed to evaluate the distribution, abundance and size composition of the Atlantic surfclam and ocean quahog populations between the Scotian Shelf and Cape Hatteras, NC Reid *et al.*.

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

One of the tasks of the Mid-Atlantic EFH Technical Team was to develop EFH alternatives for consideration by the Council. Alternatives that were developed were a result of a meeting of the Mid-Atlantic EFH Technical Team with several bluefish ecologists at the Sandy Hook Laboratory in February 1998, because the Bluefish Fishery Management Plan was the first plan to be amended with the EFH requirements of the reauthorized Magnuson-Stevens Act. At this meeting five alternatives for EFH identification recommendations were discussed for bluefish, these alternatives were to provide the basis for evaluation of the other Council managed species. These five bluefish alternatives were: 1) no action (NEPA requirement); 2) 100% of range for overfished resources; 3) the "bottleneck" concept as identified in the bluefish EFH background document where a critical area may restrict recruitment; 4) identification of EFH based on temperature or other key environmental requirement; and 5) objective criteria using some percentage of the distribution i.e. 50%, 75%, 90% or 100% Reid *et al.*. The following is a discussion for surfclams and ocean quahogs of the various alternatives and how they were approached with the Level 2 data (NEFSC Atlantic surfclam and ocean quahog survey).

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

2) The second alternative, 100% of the distribution for overfished resources, is not applicable because surfclams and ocean quahog are currently considered under-exploited.

3) The third alternative, identify bottlenecks in a history stage or to recruitment, is not applicable because no such bottlenecks are identified in the surfclam and ocean quahog EFH background document.

4) This alternative 4 approach, of identifying EFH based on key environmental requirements is not presently possible because of the lack of good quantitative habitat and environmental data corresponding to relative abundance.

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

2.2.2.1.2 Viable alternatives from the five alternatives identified above

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

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

2.2.2.1.3 Options for calculation of EFH under the threshold alternative -- alternative 5

Options under Alternative 5, the preferred alternative, are based on the relative densities and areas of higher concentrations of shellfish. Maps of EFH designation options are provided for the pre-recruits and recruit life history stage for surfclams (Figure 12a-b) and ocean quahogs (Figure 13a-b). The maps display the distribution and abundance data by ten minute squares. This is the most efficient and understandable spatial scale. The data can easily be compared to other data sets, information from the fishing industry, and existing management analyses. Although these thresholds are subjective for two reasons: 1) the cutoff points could have just as well been 40%, 60% 80%, and 100% rather than 50%, 75%, 90%, and 100%, and 2) the choice of one particular cutoff for designating EFH is based on the best professional judgements of the people involved (there is no *a priori* reason to choose 50% over 75% or 90% over 50%). However, these alternatives reflect a reasonable range of designation alternatives. The New England Fishery Management Council is approaching the identification and description of EFH in a similar manner with the assistance of the NEFSC. Four options were considered for where Level 2 data are available (offshore areas north of Cape Hatteras) using the threshold alternative (Figures 12a-b, 13a-b):

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

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

3) 90% of the observations; and

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

The Level 2 data that are summarized in the ten minute square maps came from the NEFSC Atlantic surfclam and ocean quahog dredge survey.

To create the habitat related density maps, Level 2 data from the MARMAP ichthyoplankton and/or NEFSC trawl survey were binned into ten-minute square maps. Data were assigned to a ten-minute square based on the location of the sample. Only those squares that had more than three samples and one positive catch were selected (Cross pers. comm.) The ten–minute squares were ranked from high to low based on three methods: 1) mean catch per unit effort (CPUE); 2) ln CPUE; 3) ln CPUE by area (Figures 14 and 15). A total abundance index was calculated for the entire data set by summing the mean catch for all squares. The cumulative portion of the total abundance index was calculated for the ranked ten-minute squares beginning with the lowest rank (equals highest catch). Cutoff points at 50%, 75%, 90%, and 100% of the total abundance index, were identified, and the squares at each of these cutoff points for each life stage were mapped. These groupings (50%, 75%, 90%, and 100%) represent areas of decreasing average density and increasing area. The ten-minute squares contained in the top 50%, 75%, 90% and 100% of all the ranked squares based on the ln CPUE by area were mapped separately for each life stage of surfclams and ocean quahogs (Figures 12 and 13).

Although this approach has some limitations and is based on some big assumptions, it is a scientifically objective approach that is based on the best available information. The NEFSC Atlantic surfclam and ocean quahog survey does not survey everywhere that they range, both inshore (state) and offshore (especially in the deeper waters) waters have these resources, and thus this analyzes is constrained and likely biased low. State and inshore surveys for the most part, do not exist or are not in format comparable currently to NMFS data. Few of the surveys collect the habitat information that is most needed (habitat type, substrate, biological associations, etc.). Additional sources of information (fishermen, historical, etc.) are sparse, difficult to verify, and largely anecdotal; however, public involvement in identifying and describing EFH was also solicited during the public hearing process and will be welcomed for future iterations of this work.

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

One important thing to remember is that this is not the last step in the process, but that the public, Habitat Advisors, Habitat Committee and the Council will have the opportunity to review and modify, if necessary, these EFH designations in the future through the framework process. During the public hearing process, the public was asked to comment on these designations and was able to provide additional available information. Following public review, the Council had the opportunity to modify the EFH designations based on input gathered during this process. No changes were made by the Council at the October 1998 meeting when the FMP was approved for submittal.

After reviewing the highest 75% of the area where surfclams and ocean quahogs were found in the NEFSC survey (staff's recommendation for fully utilized or underutilized species), the Council chose the preferred alternative to be the highest 90% of the area. This more inclusive approach was chosen in an effort to be risk averse. The available data only represent a portion of the surfclam and ocean quahog range, eggs and larvae are not accounted for, and these organisms are benthic and immobile. The problems identified above with this survey bias the analyses low, and thus the offshore areas are likely a minimum designation for EFH. The Council made the decision on the description of EFH (the highest 90% of the area where surfclams and ocean quahogs were collected) with the above factors in mind at the June 1998 Council meeting. There is not current information to support that any life stage appears specifically limiting in terms of an ecological bottleneck-type habitat association, and therefore to maintain consistency the Council concluded there was no justification for identifying EFH for different percentages by life stage. The Council solicited comments from the public on the appropriate percentages used for describing EFH where Level 2 data are available. Maps of the associated percentages of offshore EFH designation are in Figure 12a-b for surfclam pre-recruits and recruits (respectively), and Figure 13a-b for ocean quahog pre-recruits and recruits (respectively).

The actual area (number of 10 minute squares) for each of the standardized percentage (50%, 75%, 90%, and 100%), as well as corresponding variable percentages with catch for each of the four life stages, are presented in Tables 6 and 7. For example, Table 6 shows that the highest 90% of the surfclam catch were caught within 40% of the area (approximately 75 out of the 188 ten minute squares) where surfclams were caught, while the highest 90% of the area would encompass 169 out of the 188 ten minute squares where surfclams were caught. The logged catch analysis was not included in Tables 6 and 7 because its area is consistently between the area and catch analyses. The guidelines [Section 600.815 (a)(2)(C)(2)] state that "Density data should reflect habitat utilization, and the degree that a habitat is utilized is assumed to be indicative of that habitat value." The Technical Guidance manual (USDC 1997a) continues to explain that "EFH is the area of moderate to high abundance. However under certain conditions, habitats of low to moderate abundance may contribute to enough of the overall species productivity (e.g., reduced population size, when current population size of the species or stock is below historic levels)." Again, the Council selected one of the more inclusive approaches in its designation of offshore EFH for surfclams and ocean quahogs because they are immobile, benthic organisms that are highly dependent on their surrounding habitat.

The "preferred" alternative for EFH designation using these data was chosen to be the highest 90% of the ranked squares based on ln CPUE by area where surfclam and ocean quahogs of both pre-recruit and recruit life history stage were caught in the NEFSC surfclam and ocean quahog survey. The CPUE and logged CPUE methods were not chosen because they tend to undervalue the area that is essential to surfclams and ocean quahogs. Again, there are no readily available/data in compatible electronic format available on surfclam and ocean quahog eggs and larvae or on the distribution of surfclam and ocean quahogs within state waters.

2.2.2.2 Specific description and identification of surfclam and ocean quahog essential fish habitat

Eggs and larvae of both surfclam and ocean quahogs are not enumerated by the NEFSC MARMAP program. Also, the NEFSC clam dredge survey does not sample inshore waters, waters south of Cape Hatteras, north of Georges Bank, on any regular schedule. A depth of three feet into the substrate is specified because these animals may at times burrow to this depth (Powell pers. comm.). Specifically, identification and designation for each species is as follows:

Surfclams

Juveniles and adults: Throughout the substrate, to a depth of three feet below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of all the ranked ten-minute squares for the area where surfclams were caught in the NEFSC surfclam and ocean quahog dredge surveys (Figure 16). Surfclams generally occur from the beach zone to a depth of about 200 feet, but beyond about 125 feet abundance is low.

Ocean quahogs

Juveniles and adults: Throughout the substrate, to a depth of three feet below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of all the ranked ten-minute squares for the area where ocean quahogs were caught in the NEFSC surfclam and ocean quahog dredge surveys (Figure 17). Distribution in the western Atlantic ranges in depths from 30 feet to about 800 feet. Ocean quahogs are rarely found where bottom water temperatures exceed 60 °F, and occur progressively further offshore between Cape Cod and Cape Hatteras.

Since the NEFSC clam survey only briefly (no stratified random design) surveyed the Gulf of Maine twice in the early 1990s, no attempt is currently made to designate EFH for the small artisanal fishery that occurs north of 43° 50' north latitude at this time. The State of Maine is desirous of sampling this resource to quantify its extent, however no definitive plans are yet in place. It was proposed during the comment period that although no data exist to map even the presence or absence of the resource reliably (i.e., there is "Level 0" data), the habitat supports a resource that sustains a small fishery and thus it would seem worthwhile to attempt to identify valuable habitat areas through discussions with the fishing industry to designate EFH in the Gulf of Maine. No comments were received from Maine fishermen or state representatives that would provide useful anecdotal information. The Council has determined that when Maine performs a survey and has useful quantitative data to designate EFH, the information will be supplied to the Habitat Monitoring Committee for their review.

A similar comment was received from NMFS in that the Council should consider designating EFH in state waters. The Council initially chose to designate only EFH in the EEZ since that is the management unit for this FMP. The Council, upon review of the description and identification at the June Council meeting solicited recommendations from the states as to whether EFH should be identified in state waters. Only New York replied that they consider their state waters important for surfclams. At least the States of New York and New Jersey perform clam surveys in their state waters and the Habitat Monitoring Committee should consider expanding the identification of EFH into state waters in the future.

Finally, the MAFMC solicited input from the public and state personnel on where they perceive EFH should be designated for surfclams and ocean quahogs. Only one response in the form of a map was received from the State of Massachusetts and those comments were incorporated into the EFH figures. Additional comments on Figures 18 and 19 will be welcomed in future iterations of this FMP. The Council anticipates that as the Sandy Hook project to compile and format all the various state surveys is completed, the Habitat Monitoring Committee will review those data and are likely to provide suggestions on whether EFH for these two species should extend inshore of the EEZ into state controlled waters.

2.2.2.2.1 Identification of Habitat Areas of Particular Concern

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

The MAFMC is not recommending any portions of EFH as HAPC for surfclams or ocean quahogs at this time. This is because no strong associations between habitat type or location and recruitment for these species have been identified in the EFH background documents (section 2.2.1). The information in the EFH background documents appear inadequate at this time to put a high priority on any specific habitat. However, the Council is recommending the Secretary identify HAPCs for summer flounder in that FMP and Council does expect to designate additional HAPCs for other species as more data become available. Designation of HAPCs is a frameworked measure so the Council will have the flexibility to establish or modify HAPC designations as further information becomes available. The Council intends to use the framework process identified in section 2.2.8 and work through the Habitat Monitoring Committee for future consideration of HAPCs.

2.2.3 Fishing Activities that May Adversely Affect EFH

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

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

The discussion of the wide range of effects of fishing on EFH is based on the definition of EFH within the Act and the technical guidance produced by NMFS to implement the Act. The Act defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." For the purpose of interpreting the definition (and for defining the scope of this report), "waters" is interpreted by NMFS as "aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate" and "substrate" is defined to include sediment, hard bottom, structures, and associated biological communities. These definitions provide substantial flexibility in defining EFH based on our knowledge of the different species, but also allows EFH to be interpreted within a broader ecosystem perspective. Disturbance has been defined as "any discrete event in time that disrupts ecosystem, community, or population structure and changes resources, substrate availability, or the physical environment" (Pickett and White 1985). From an ecological perspective, fishing with fixed and mobile gear is the most widespread form of direct disturbance in marine systems below depths which are affected by storms (Watling and Norse 1997). Disturbance can be caused by many natural processes such as currents, predation, iceberg scour (Hall, 1994). Human caused disturbance can result from activities such as harbor dredging and fishing with mobile gear. Disturbance can be gauged by both intensity (as a measure of the force of disturbance) and severity (as a measure of impact on the biotic community). Table 8 summarizes the relative effects of the range of agents which produce disturbances in marine communities.

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

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

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

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

1) Effects on structural components of habitat;

2) Effects on community structure; and

3) Effects of ecosystem processes.

2.2.3.1 Effects on structural components of habitat

Habitat has been defined as "the structural component of the environment that attracts organisms and serves as a center of biological activity" (Peters and Cross 1992). Habitat in this case is defined as the range of sediment types (i.e., mud through boulders), bed forms (e.g., sand waves and ripples, flat mud), as well as the co-occurring biological structures (e.g., shell, burrows, sponges, seagrass, macroalgae, coral). A review of 22 studies (Table 9) all show measurable impacts of mobile gear on the structural components of habitat (e.g., sand waves, emergent epifauna, sponges, coral), when defining habitat at this spatial scale. Results of each of the studies show similar classes of impacts despite the wide geographic range of the studies (i.e., tropical to boreal). In summary, mobile fishing gear reduced habitat complexity by: (1) directly removing epifauna or damaging epifauna leading to mortality, (2) smoothing sedimentary bedforms and reducing bottom roughness, and (3) removing taxa which produce structure (i.e., taxa which produce burrows and pits). Studies which have addressed both acute and chronic impacts have shown the same types of effects.

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

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

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

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

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

Empirical studies that most directly link changes due to gear impacts changes on habitat structure to population responses are being carried out in Australia. Sainsbury (1987,1988, and 1991) and Sainsbury *et al.* (In press) have shown a very tight coupling between a loss of emergent epifauna and fish productivity along the north west continental shelf. In these studies, there was a documented decline in the bycatch of invertebrate epifauna, from 1000 pounds/hr to only a few pounds/hr, and replacement of the most commercially desirable fish associated with the epifaunal communities by less valuable species associated with more open habitat. By restricting fishing, the decline in the fish population was reversed. This corresponded to an observed recovery in the epifaunal community, albeit the recovery for the larger epifaunal invertebrates showed a considerable lag time after trawling ceased. This work is based on a management framework which was developed to test hypotheses regarding the habitat dependence of harvested species.

The hypotheses, described in Sainsbury (1988 and 1991), assessed whether population responses were the result of: (1) independent single-species (intraspecific) responses to fishing and natural variation, (2) interspecific interactions such that, as specific populations are reduced by fishing, non-harvested populations experienced a competitive release, (3) interspecific interactions such that, as non-harvested species increase from some external process, their population inhibits the population growth rate of the harvested species, and (4) habitat mediation of the carrying capacity for each species, such that gear induced habitat changes alter the carrying capacity of the area.

2.2.3.2 Effects on community structure

An immediate reduction in the density of non-target species is commonly reported following impact from mobile gear (Table 10). In assessing this effect, it is common to compare numbers and densities for each species before and after trawling and/or with an undisturbed reference site.

Time series data sets that allow for a direct long-term comparison of before and after fishing are essentially nonexistent, primarily because the extent to which the worlds oceans are currently fished was not foreseen, or because time series data collection focused on the fish themselves rather than the impact of fishing on the environment. Nevertheless, there are several benthic data sets that allow for an examination of observational or correlative comparisons before and after fishing (Table 11). Long-term effects of fishing included reduced densities of certain types of macrobenthos including sponges, coelenterates, bivalves, as well as seagrass meadows and increases in taxa such as polychaete. Other shifts occurred; for example decline in sea urchins to an increase in brittle stars, a decline in deposit feeders and an increase in suspension feeders and carnivores, as well as a decline in animal size.

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

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

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

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

2.2.3.3 Effects on ecosystem processes

A number of studies indicate that fishing has measurable effects on ecosystem processes. Disturbance by fishing gear in relatively shallow depths (i.e., 100 - 130 feet depth) can reduce primary production by benthic microalgae. Recent studies in several shallow continental shelf habitats have shown that primary production by a distinct benthic microflora can be a significant portion of overall primary production (i.e., water column plus benthic primary production; Cahoon and Cooke 1992; Cahoon *et al.* 1990). Benthic microalgal production supports a variety of consumers, including demersal zooplankton (animals that spend part of each day on or in the sediment and migrate regularly into the water; Cahoon and Tronzo 1992). Demersal zooplankton include harpacticoid copepods, amphipods, mysids, and other animals that are eaten by planktivorous fishes and soft bottom foragers (Thomas and Cahoon 1993).

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

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

2.2.3.1 Direct alteration of food web

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

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

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

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

2.2.3.4 Summary

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

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

2.2.3.7 Fishing gear used within the surfclam and ocean quahog range

Commercial fishing gear used in 1995 from Maine to Virginia is characterized in Table 12. Fishing gear which caught 1% or more of the landings for the Mid-Atlantic Council-managed species from Maine to Virginia in 1995 is presented in Table 13. These data were summarized from the 1995 unpublished NMFS weighout data. While total pounds of all species landed is not necessarily an indication of effort, it is some indication of overall fishing in both state and federal waters. Bottom gear used from Maine to Virginia includes bottom otter trawls, clam dredges, sea scallop dredges, and other dredges. Fishing gear that is managed by the South Atlantic Council is presented in Table 14.

2.2.3.8 Fishing impacts to surfclam and ocean quahog EFH

Any mobile gear that comes into contact with the seafloor in surfclam and ocean quahog EFH may potentially have an impact to these immobile benthic organisms (Table 15). The gears expected to have the most adverse impact are hydraulic clam dredges and the scallop dredges.

From Auster and Langton (1998) we know that hydraulic clam dredges damage buried bivalves when the dredge does not fully penetrate the bottom to a depth below the horizon where clams occur (Meyer *et al.* 1981). The cutting bar directly breaks clam valves from the force of the dredge moving laterally through the sediments and pushing against high densities of clams. In all studies, the authors made reasonable assumptions regarding levels of damage which will result in direct mortality (e.g., broken hinge, removal of a valve, exposure of soft tissues). However, no studies followed individuals to assess long term mortalities based on damage such as chipped shell margins, which may increase the risk of predation from crustacean predators. The issue of mortality associated with catching but not landing is included in each of the recent stock assessments for surfclams (NEFSC 1998a) and ocean quahogs (NEFSC 1998b).

Assessment of impacts of hydraulic clam dredges in the Middle Atlantic in a closed area with high densities of surfclams by Meyer *et al.* (1981) indicated that when dredge efficiency was low, larger clams which were buried deeper had mortalities as high as 92%. When dredge efficiency was high, mortalities were approximately 30% (in Auster and Langton 1998).

Murawski and Serchuk (1989) studied the short-term impacts on benthic communities of bivalve harvest operations in the Middle Atlantic Bight, including scallop dredge and hydraulic clam dredge on various substrate types. Scallops harvested on soft sediment (sand or mud) had low dredge induced mortality for un-caught animals (less than 5%). Culling mortality (discarded bycatch) was low, approximately 10%. Over 90% of the ocean quahogs that were discarded re-burrowed and survived whereas 50% of the surfclams died. Predators such as crabs, starfish, fish and skates, moved in on the ocean quahogs and surfclams within 8 hours post dredging. Murawski and Serchuk (1989) noted numerous "minute" predators feeding in trawl tracks. Non-harvested animals, sand dollars, crustaceans and worms were significantly disrupted but sand dollars suffered little apparent mortality.

Meyer *et al.* (1981) evaluated clam dredge (harvesting ocean quahogs) efficiency over a transect in Long Island Sound, NY. After the dredge passes, it creates a "windrow of clams". The dredge penetrates up to 12 inches and pushes sediment into track shoulders. After 24 hours the track looks like a shallow depression. Clams can be cut or crushed by dredge with mortality ranging from 7 to 92%, being dependent on size and location along dredge path. Smaller clams survive better and are capable of re-burrowing in a few minutes. Predators such as crabs, starfish and snails, move in rapidly and depart within 24 hours.

MacKenzie (1982) studied the long-term impacts of harvesting ocean quahogs in fine to medium sand areas in Southern New Jersey. In areas that are unfished, recently fished, and currently fished for ocean quahogs using hydraulic dredges invertebrates were sampled with a Smith MacIntyre grab. Few significant differences in numbers of individuals or species were noted, and no pattern suggested any relationship to dredging.

The surfclam and ocean quahog fisheries are ITQ fisheries, and as such there is no reason that fishermen have a "rush to fish". One of the great benefits of ITQ fisheries from around the world is that it instills the sense of private property rights and ownership in the resource. Fishermen in these fisheries understand that they are not time driven to rape the resource and that by protecting the resource and its environment they are protecting their long term livelihoods. Unquestionably, ITQs and the way clams are now fished alleviate some environmental damage (Wallace pers. comm.)

The numbers of surfclam and ocean quahog fishermen have also decreased significantly with the implementation of ITQs. In 1979 there were 162 permitted surfclamming vessels. That number had fallen to 135 vessels the year before (1989) implementation of the ITQ program, and by 1995 the number was only 37. For ocean quahogs the number of vessels were: 59 in 1979, 69 in 1989 and 36 in 1995. Many vessels fish for both surfclams and ocean quahogs and in fact the total number of vessels that fished in 1997 was only 50. Most of these current vessels also use sorting machines which make it possible to harvest broken clams which are now not discarded.

A brief discussion on the concept of reserves, or areas where clam dredging would not be allowed, occurred at the June 1998 SARC. The idea of reserves was dismissed at this time by the SARC when it was quickly calculated that the greatest possible impact to the bottom, of all the clam dredging for an entire year, would be less than 100 square miles per year. Putting this in context, this 100 square miles is roughly the area of one ten minute by ten minute square. There are over 1200 ten minute squares in the EEZ between Cape Hatteras and Georges Bank.

With the above limited gear impact statements (Auster and Langton 1998), the minimal bottom impact of only 50 vessels, and statements of internationally known invertebrate experts (Drs. Roger Mann of VIMS and Eric Powell of Rutgers who state that the bottom is stirred up more from the average Northeaster than from surfclam dredging) the Council believes that no specific management measures should be proposed for this fishery at this time. The Council solicited public input on clam dredge gear impact during the public hearing process.

2.2.4 Options for Managing Adverse Effects from Fishing

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

According to section 600.815 (a)(3) Councils must act to prevent, mitigate, or minimize adverse effects from fishing, to the extent practicable, if there is evidence that a fishing practice is having an identifiable adverse effect on EFH. Evidence of various gear impacts on bottom in the Mid-

Atlantic region has been presented to the Council over the past several years. It is because of this anecdotal information that the Council is considering that all mobile gear coming into contact with the seafloor within surfclam and ocean quahog EFH is characterized as having a potential impact on their EFH (Table 15). However, the effort of these bottom tending gears is largely unquantified from data that are presently collected by the NEFSC as summarized by Auster and Langton (1998) and therefore no management measures will be proposed at this time.

The requirement concerning gear impact management is to the extent practicable given the evidence that the fishing practice is having an identifiable adverse effect. The Council feels strongly that very little evidence was provided in the synthesis document of Auster and Langton (1998) relative to identifiable adverse effects to EFH in FMPs managed by this Council at this time. Fishing gear impacts along with the description and identification of EFH are frameworked management measures which can easily and readily be changed as more information becomes available. The Council's Habitat Monitoring Committee (section 2.2.8) should be meeting annually and can provide recommendations concerning gear impacts that NMFS and the Council can act on in the future. The Council feels it would be premature, given the lack of identifiable adverse effects of gear impacts to these managed species EFH, to propose gear management measures at this time. It is simply not practicable to impose unwarranted management measures that are unjustifiable. The Council will consider implementing management measures to protect EFH if and when adverse gear impacts are identified.

2.2.5 Non-Fishing Activities that May Adversely Affect EFH

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

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

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

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

The threats addressed in this section are germane to the entire Atlantic coast. All Mid-Atlantic Council managed species exist outside the geographic boundaries of Mid-Atlantic Council.

Knowledgeable NMFS/Council individuals were asked to identify and prioritize non-fishing "perceived" threats. Once this list was complete, the resulting paper was distributed for review via mail, workshops, and conferences. The list is prioritized in regards to (1) perceived threats of habitat managers and others in the environmental community and (2) potential impact to surfclam and ocean quahog habitat (Table 15). Information from the ASMFC workshop (Stephan and Beidler 1997) for habitat managers, which included a broad spectrum of constituents, was also used to identify threats.

Measures for conservation and enhancement of EFH

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

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

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

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

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

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

2.2.5.1 Habitat threats prioritized for surfclam and ocean quahog EFH

Many anthropogenic (man is the source) actions threaten the integrity of surfclam and ocean quahog EFH. These threats have been prioritized based on the following:

Surfclams and ocean quahogs are benthic, immobile species. All currently proposed surfclam and ocean quahog EFH is located in Federal waters (EEZ only since that is the management unit for these two shellfish), however important habitat is also located in state waters. Land based threats which are expected to contribute to cumulative adverse impacts to ocean quahog and surfclam EFH may appear high in priority, e.g. coastal development and nonpoint source pollution. Threats that may have significant but localized impacts to habitat e.g. dredging but will not impact offshore surfclam and ocean quahog EFH will appear lower in priority. Offshore activities that could occur in EFH, but which are not perceived as important threats in other MAFMC FMPs, may be high in priority in this FMP because they could be located in surfclam and ocean quahog EFH, e.g. marine mining, energy production/transport and artificial reefs.

Several instances of severe depletion of dissolved oxygen in the bottom waters of the ocean along the New Jersey and Long Island coasts have produced surfclam and ocean quahog mortalities. A major event of this type occurred in the spring and summer of 1976. Anoxic water developed over clam beds between Cape May, New Jersey and Long Island's south shore, out to a depth of 250 feet, because of the combined effects of meteorological and hydrographic conditions, organic loading from human waste dump sites, and an unusually large bloom and die off of the dinoflagellate *Ceratium tripos* (Steimle and Sindermann, 1978). The kill area was estimated at 2,600 square miles, and resulted in a decrease in New Jersey surfclam biomass of 78.5 percent and a decrease in biomass in New Jersey ocean quahogs of 7.1 percent (Ropes *et al.* 1979).

All available evidence indicated that the specific events that caused development of anoxic bottom waters in 1976 were: (1) an unusually warm winter, with highest river runoff in February rather than April, thus allowing early development of dense dinoflagellate populations; (2) earlier than normal thermal stratification, sealing off organically rich, oxygen demanding water early in the spring; (3) additional organic loading from human waste dump sites off New Jersey and Long Island; (4) limited water mass movement for an extended period, due to a persistent southerly flow of air; and (5) abnormally low cyclonic storm activity over the same 4 to 6 week period. Any one of these events probably would not have caused oxygen depletion to the extent observed, but together they devastated New Jersey and Long Island surfclam populations (Steimle and Sindermann, 1978).

Little specific information is available concerning the long term or short term dissolved oxygen requirements of surfclams or ocean quahogs. However, since part of the estimated kill zone in 1976 was between the 1.0 and 2.0 ppm dissolved oxygen isopleths, a lower lethal limit of 2.0 ppm can be assumed until more detailed information on oxygen requirements is collected (Fay *et al.* 1983).

Two major classes of pollutants have been documented to affect surfclam and ocean quahog populations or exploitation of those populations: (1) human refuse, sewage, and sludge (ocean dumping) and (2) metals.

Zoellner (1977) reviewed water quality problems related to molluscan shellfish and the effectiveness of current discharge control laws. Although natural phenomena, dredging, and chemical contamination were all noted as having significant impacts on shellfish populations, he considered domestic waste discharge to have the greatest negative impact on sanitary conditions in and around shellfish beds. Positive fecal coliform counts were reported in 70% of surfclam samples taken offshore of Delaware Bay in 1966 and 1967 (Buelow, 1968).

The continual leaching of contaminants from oceanic dump sites into the water and sediments and the uptake by sedentary oceanic fauna have forced closure of various important clam harvesting areas of the mid Atlantic Bight 1960s, 1970s and 1980s (Fay *et al.* 1983). Elevated concentrations of iron and copper (Lear *et al.* 1973) and chromium and nickel (Buelow, 1968) were found in surfclams collected near sewage and acid waste dump sites offshore of Delaware Bay.

Relatively high concentrations of cadmium, copper, nickel, vanadium, chromium, and zinc were found in surfclams from Delaware Bay (Reynolds, 1979), though sample sizes were too small to test statistically. Mean arsenic concentrations for all stations in the mid Atlantic Bight were 2.1 ppm in surfclams and 3.0 ppm in ocean quahogs, a range exceeding allowable levels (1.14 ppm) recommended by the Australian National Health and Medical Research Council (Wenzloff *et al.* 1979). The US EPA has not established recommended levels for arsenic, however since the distribution of arsenic concentrations did not vary greatly with latitude, it may indicate that background levels along the mid Atlantic coast are higher than those in Australian waters (Wenzloff *et al.* 1979).

Surfclams and ocean quahogs are exposed to a range of environmental conditions and contaminants during their life history. Assessments made by the Ocean Pulse and Northeast Monitoring Programs indicate extensive, detrimental amounts of toxic organic and inorganic contaminants, such as heavy metals, PCBs, and petroleum hydrocarbons in the various physical compartments of the marine ecosystem (Boehm and Hirtzer 1982, Boehm 1983, Reid *et al.* 1982). This is particularly true for sediments in the Mid-Atlantic Bight that have received contaminated dredged materials, sewage sludge, and industrial wastes. Elevated levels of petroleum hydrocarbons have even been found in small estuaries as far north as Maine. Elevated PCB levels have been found in sediments and biota in Buzzards Bay, in the New York Bight apex, and other places (Reid *et al.* 1982).

Polychorinated biphenyls (PCBs) are suspected carcinogens to humans; however, comprehensive research has not yet been done on the significance of elevated body burdens to the shellfish themselves, or to reproductive processes and subsequent recruitment of larval, juvenile, and pre-recruits to adult shellfish stocks. Laboratory and field effects of a range of organic contaminants have been measured; however, how contaminants such as PCBs affect the behavior, biochemistry, genetics, or physiology of these shellfish at either the lethal or sublethal levels is not well understood. It is significant that where elevated levels of PCBs have been reported in the marine environment, they have generally been associated with elevated levels of toxic heavy metals, petroleum hydrocarbons, and other contaminants and thus the deleterious effects may be more pronounced.

Most research on the toxicological effects of various contaminants in shellfish is recent. Many anomalies probably have not been described or their magnitude documented. The Councils encourage fishermen to report or provide shellfish with tumorous type growths to: Dr. John C. Harshberger, Director, Registry of Tumors in Lower Animals, Smithsonian Institution, Museum of Natural History, Washington, DC 20560 (202-357-2647).

Coastal areas are vitally important for surfclams and ocean quahogs. Our knowledge and understanding of the influence of estuarine "outwellings" (plumes) on the contiguous shelf ecosystems is in its infancy (Campbell and Thomas, 1981), but the significant existence is certainly undeniable. Population shifts to coastal areas and associated industrial and municipal expansion have accelerated competition for use of the same habitats. It was projected (48 FR 53142-53147) that by 1990, 75% of the US population will live within 50 miles of the coastlines (including the Great Lakes). As a result, these habitats have been substantially reduced and continue to suffer the adverse effects of dredging, filling, coastal construction, energy development, pollution, waste disposal, and other human related activities. In the case of wetlands, from 1954 to 1978 there was an average annual loss of 104,000 acres which was a ten fold annual increase in acreage lost between 1780 and 1954 (48 FR 53142-53147). The pressure on coastal and ocean habitats is nowhere greater than in the densely populated, industrialized Northeast. It is obvious that new systems are needed to conserve habitats and living marine resources, while facilitating the completion of necessary, compatible economic developments. Toward this goal, NMFS issued its formal Habitat Conservation Policy in November 1983 (48 FR 53142-53147). The goal of the policy is: "to maintain or enhance the capability of the environment to ensure the survival of marine mammals and endangered species and to maintain fish and shellfish population which are used, or are important to the survival and/or health of those used, by individuals and industries for both public and private benefits - jobs, recreation, safe and wholesome food and products". The Habitat Conservation Policy provided impetus to NMFS's Regional Action Plan (RAP) process which is to foster coordinated management and research responses to major habitat conservation issues and problems, and to develop better steps to address them in the future (USDC, 1985a).

Surfclams and ocean quahogs are subject to numerous man caused habitat threats. Rather than spend extensive efforts detailing degradation in individual oceanic systems (an effort generally already being performed by the individual States), this section will broadly address the major types of abuse (that is, agricultural, urbanization, and industrialization) dominant in the largest, most important areas (that is, Chesapeake Bay, Hudson River/Long Island Sound, and the New England coast).

Extensive urban development along the western shore of the Chesapeake has resulted in human population and industrial growth at the expense of the natural environment. The Baltimore-Washington-Norfolk corridor is a major demographic region where numerous commercial and industrial activities are centered. These activities have adversely affected the environment through habitat modification and destruction, and the introduction of contaminants in point and non-point source discharges. The eastern shore of the bay is primarily agricultural and residential. Uncontrolled agricultural and suburban runoff, however, also introduces significant quantities of sediments, trace metals, and chemicals that degrade water quality.

The Hudson River/Long Island Sound area is heavily urbanized and in parts industrialized or supportive of large-scale agriculture. The middle and upper Hudson River valley and eastern Long Island support extensive agricultural areas and large populations with the associated habitat abuses. The lower portion of the Hudson River area, northern New Jersey, and western Long Island are inhabited by the greatest concentration of people anywhere in the US as well as supporting extensive utility, petro-chemical, and other heavy industry.

The New England coast, since heavily developed, has some of all three major types of abuse. However, the areas are generally localized (that is, an individual power generating station or urbanized center) and since the estuaries are only used on a limited basis, the abuses do not seem as detrimental as those in the previously mentioned systems.

In summary, the most concise synopsis of the health of the Nation's marine environments can be viewed as that presented in the findings of the Office of Technology Assessment (OTA) report (1987):

> "Estuaries and coastal waters around the country receive the vast majority of pollutants introduced into marine environments. As a result, many of these waters have exhibited a variety of adverse impacts, and their overall health is declining or threatened.
>
> "In the absence of additional measures, new or continued degradation will occur in many estuaries and some coastal waters around the country during the next few decades (even in some areas that exhibited improvements in the past)."

The Council in efforts to coordinate with NMFS has adopted the NMFS Regional Action Plan's (USDC 1985a) identified environmental trends as potential issues that may affect the habitats of surfclams and ocean quahogs.

Estuarine and coastal lands and waters are used for many purposes that often result in conflicts for space and resources. Some uses may result in the absolute loss or long term degradation of the general aquatic environment or specific aquatic habitats, and pose theoretically significant, but as yet unquantified, threats to the biota and their associated habitats. Issues arising from these activities, and the perceived threats associated with them, are of serious concern to the public.

Multiple-use issues are constantly changing, as are the real or perceived impacts of certain activities on living marine resources. The coastal and oceanic activities that generate these issues can threaten living marine resources and their habitats. Threats to resources occur when human activities cause changes in physical habitat, water and sediment chemistry, and structure and function of biological communities.

The following discussion identifies and describes each multiple use issue and the potential threats associated with that issue (USDC 1985a). For the purposes of this discussion, an "issue" is a point of debate or controversy evolving from any human activity, or group of activities, that results in an effect, product, or consequence. Environmental and socio-economic issues remaining to be resolved satisfactorily with regard to their impacts on marine organisms, their habitats, and man developed from the multiple, often conflicting uses of coastal lands and waters.

Based on these considerations, threats that impact estuaries, inshore areas, and water quality are priority concerns in surfclam and ocean quahog EFH (Table 15). The threats may be primary, direct (e.g., physically removing habitat by dredging or filling) or secondary, indirect (e.g., water quality degradation caused by urban or agricultural runoff). Many of the threats associated with surfclam and ocean quahog EFH result in both primary and secondary impacts (e.g., coastal development, dredging and spoil disposal). Collectively, these impacts are "cumulative", which are often synergistic (i.e., the whole is greater than the sum of its parts). Some of the more challenging cumulative impacts are discussed in Section 2.2.5.14.

A more detailed discussion of the habitat threats affecting surfclam and ocean quahog EFH and other Atlantic coast habitats follows. The described threats, and associated enhancement or mitigative recommendations, are related to both direct and indirect impacts. Again, their priority with respect to surfclam and ocean quahog EFH is identified in Table 16.

2.2.5.2 Coastal development

Coastal development involves changes of land use; these activities include urban, suburban, commercial, and industrial, including the construction of corresponding infrastructure. Coastal development also includes clearing of forestlands and filling of wetlands for agricultural use. Development first occurred in the coastal areas, and this historical trend continues. Approximately 80 percent of the Nation's population lives in coastal areas (USEPA 1993). The U.S. Census Bureau estimates the 1997 world population to be 267.7 million in the United States and 5.84 billion in the world. The US population rose 85 percent within 50 miles of the coastlines between 1940 and 1980, compared to 70 percent for the nation as a whole. The US Census Bureau projects that by the year 2000, the US population will reach 275 million, more than double its 1940 population.

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

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

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

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

Measures for conservation and enhancement

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

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

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

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

2.2.5.2.1 Water withdrawal and diversion

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

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

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

Measures for conservation and enhancement

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

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

2.2.5.2.2 Construction

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

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

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

1. The nature of the construction activity;

2. The physical characteristics of the construction site; and

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

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

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

Measures for conservation and enhancement

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

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

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

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

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

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

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

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

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

2.2.5.2.3 Construction of infrastructure

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

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

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

Measures for conservation and enhancement

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

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

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

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

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

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

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

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

2.2.5.2.4 Shoreline stabilization

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

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

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

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

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

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

Measures for conservation and enhancement

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

B). Vegetative shoreline stabilization should be implemented whenever feasible.

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

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

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

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

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

2.2.5.3 Marine mining

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

Consumption of sand from offshore shoals is occurring on al large scale along the U.S. Atlantic coast. Although the offshore shoals are actively being modified by waves and currents, they are relict features which formed at times of lower sea level. As such, once lost, they are not expected to be replaced by natural processes. Cumulative environmental impacts to finfish are expected to since loss of offshore shoals will reduce habitat diversity on the U.S. inner continental shelf.

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

Measures for conservation and enhancement

A). Sand mining and beach nourishment should not be allowed in surfclam and ocean quahog EFH.

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

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

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

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

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

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

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

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

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

2.2.5.4 Nonpoint source (NPS) contamination

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

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

Nonpoint pollution is the pollution of our nation's waters caused by rainfall or snowmelt moving over and through the ground. Ground water is an important source of surface water and nutrients. The U.S. Geologic Survey (USGS) has determined that 50% of the water in streams comes from ground water. The amount of ground water varies according to the type of rock and sediment beneath the land surface (USGS 1997). Up to one-half of the nitrogen entering the Chesapeake Bay travels through the ground water (USGS 1997). It is possible that about 10% to 20% of the phosphorous entering the Chesapeake Bay also travels through ground water (USGS 1997). Atmospheric deposition transports about 9% of the nitrogen and 5% of the phosphorous loads to the Chesapeake Bay (Alliance for Chesapeake Bay 1993).

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

2.2.5.4.1 Urban NPS

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

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

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

Measures for conservation and enhancement

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

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

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

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

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

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

2.2.5.4.2 Agricultural NPS

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

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

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

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

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

Measures for conservation and enhancement

A). EPA and appropriate agencies should establish and approve criteria for vegetated buffer strips in agricultural areas adjacent to coastal waters to minimize pesticide, fertilizer, and sediment loads which can cumulatively adversely impact surfclam and ocean quahog EFH. The effective width of these vegetated buffer strips should vary with slope of terrain and soil permeability.

B). The Natural Resources Conservation Service and other concerned federal and state agencies should conduct programs and demonstration projects to educate farmers on improved agricultural practices that would minimize the wastage of pesticides, fertilizers, and top soil and reduce the cumulative adverse effects of these materials on surfclam and ocean quahog EFH areas (MAFMC 1988).

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

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

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

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

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

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

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

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

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

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

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

2.2.5.4.3 Silvicultural NPS

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

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

Measures for conservation and enhancement

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

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

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

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

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

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

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

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

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

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

2.2.5.5 Energy production and transport

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

2.2.5.5.1 Hydroelectric

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

1. Dissolved oxygen concentrations and temperature;

2. Create artificial destratification;

3. Withdraw or divert water;

4. Change sediment load;

5. Change channel morphology;

6. Accelerate eutrophication;

7. Change nutrient cycling; and

8. Contaminate water and sediment.

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

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

2.2.5.5.2 Nuclear

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

2.2.5.5.3 Fossil fuels

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

2.2.5.5.4 Offshore oil and gas operations

The Outer Continental Shelf (OCS) exploratory and production drilling and transport may affect biota and their habitats. Oil spills resulting from well blowouts, pipeline breaks, and tanker accidents are of major concern. Contaminants from oil exploration include mostly petroleum hydrocarbons and heavy metals. Effects of hydrocarbon contamination in the water column and sediments may include: mortality of larval fish; mortality from predation due to slower avoidance behavior; bioaccumulation in fish; migration interference for salmon and other anadromous species; slower maturation of larvae (Howarth 1991). Sublethal effects can cause a decrease in recruitment, as well as complex ecological interactions (Howarth 1991). Cumulative effects of oil on ecosystems include changes in benthic community structure and possible changes in planktonic community structure (Howarth 1991). Oil and gas exploration in the Mineral Management Service's (MMS) Mid-Atlantic, North Atlantic, and South Atlantic lease areas may result in loss or degradation of benthic habitat from the deposition of discharged drilling muds and cuttings. Should production of oil and gas occur in these areas, the transport of the products to onshore storage and processing facilities would pose additional threats to coastal zone and estuarine ecosystems (USDC 1985a).

Measures for conservation and enhancement

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

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

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

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

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

F). NPDES permit conditions, such as those relating to water quality under the Clean Water Act, should be monitored and strictly enforced in surfclam and ocean quahog EFH.

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

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

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

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

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

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

2.2.5.6 Artificial reefs

The use of artificial reefs can be a sound and effective tool in fishery development and management (ASMFC 1992). However the National Fishing Enhancement Act of 1984 (P.L. 98-623, Title II), states that "artificial reef materials...should minimize environmental risks" and that proposed materials should uphold the standards of "function, durability, stability, availability, compatibility, and safety" (ASMFC 1993). All reef materials should be identified and acceptable in the National Artificial Reef Plan (USDC 1985b) or the Reef Material Criteria Handbook (ASMFC 1992) or revisions thereof (MAFMC 1995). All materials should be compatible with characteristics of the sites such as wave energy and salinity (MAFMC 1995). Two examples of inappropriate reef materials include combustion/incineration ash and tires. Combustion/incineration ash products are potentially unstable over long time periods, as well as, potentially toxic (ASFMC 1993). Tires become toxic to certain organisms in low salinities; tire structure can also breakdown and move due to the high energy of ocean currents (MAFMC 1995).

Measures for conservation and enhancement

The MAFMC readopts the five policy statements, from June 1995, on artificial reefs and the associated effects of reef activities on fisheries under Council authority.

A). Each new EEZ artificial reef site proposal must have a stated conservation and management objective.

B). The impact of building an artificial reef to surfclams and ocean quahogs must be evaluated by the project proponent before building an artificial reef in surfclam and ocean quahog EFH.

C). The MAFMC endorses the National Artificial Reef Plan (USDC 1985b) and encourages staff to work with ASMFC, NMFS, and the States in the updating of the plan.

D). Only materials identified and acceptable in either the National Artificial Reef Plan (USDC 1985b) or the Reef Material Criteria Handbook (ASMFC 1992) or revisions thereof should be used for the creation of artificial reefs.

E). No fishery management regulations may be implemented for any artificial reef in the EEZ without concurrence by the MAFMC.

F). The Council will attempt to facilitate communication on the siting of any new artificial reef in the EEZ with various user groups of the proposed site by Federal fisheries agencies and neighboring States' fisheries agencies.

2.2.5.7 Dredging and disposal of dredged material

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

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

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

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

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

5. Noise/disturbance to terrestrial organisms;

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

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

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

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

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

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

Measures for conservation and enhancement

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

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

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

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

E). "Beneficial Use" proposals in surfclam and ocean quahog EFH should be compatible with existing uses by surfclams and ocean quahogs. Conflicting uses, such as construction of bird breeding islands, should not be authorized.

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

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

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

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

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

2.2.5.8 Port development, utilization, and shipping

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

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

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

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

Construction activities associated with port development result in a loss of habitat diversity along the water's edge. Bulkheading, filling, and construction of port features result in general water quality degradation that reduces biotic diversity of important productive areas (USDC 1985a). Habitat types that are destroyed by construction of port infrastructure include, shallow bay bottom, shoreline wetlands, seagrass meadows and intertidal wetlands (Fehring 1983). The effect of loss of these habitats include loss of nursery area, reduction in water clarity, and shifts in primary productivity (Fehring 1983).

Measures for conservation and enhancement

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

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

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

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

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

2.2.5.9 Aquaculture

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

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

Measures for conservation and enhancement

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

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

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

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

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

2.2.5.10 Ocean disposal

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

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

Measures for conservation and enhancement

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

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

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

2.2.5.11 Marinas and recreational boating

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

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

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

1. Poorly flushed waterways where dissolved oxygen deficiencies exist;

2. Pollutants discharged from boats;

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

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

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

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

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

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

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

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

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

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

A workshop on the environmental impacts of boating held at Woods Hole Oceanographic Institute, December 1994, summarizes the substantiated impacts of boating activity. These include: sediment and contaminant resuspension and resultant turbidity; laceration of aquatic vegetation with loss of faunal habitat and substrate stability; toxic effects of chemical emissions of boat engines; increased turbulence; shearing of plankton; shorebird disturbance; and the biological effects of chemically treated wood used in dock and bulkhead construction. Many of these issues and concerns remain inadequately described. Sufficient hard data was referred to or presented at the workshop, that recreational and commercial motor boat operation is far from a benign influence on aquatic and marine environments. This is particularly so in temperate climes due to the unfortunate synchrony, with only a few exceptions, of vertebrates and invertebrates in estuaries and coastal waters. Therefore, the chance of plants and organisms being affected by power boat operation ought to be regarded as privilege which requires due consideration of environmental impacts, and should be conducted and managed in such a manner.

Measures for conservation and enhancement

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

2.2.5.12 Sewage treatment and disposal

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

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

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

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

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

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

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

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

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

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

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

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

Measures for conservation and enhancement

A). All sewage should go through tertiary treatment (i.e., nutrient removal) when discharged in waters adjacent to coastal waters.

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

C). All NPDES permits of public owned treatment works (POTWs) should be reviewed and strictly enforced when adjacent to coastal waters.

2.2.5.13 Industrial wastewater and solid waste

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

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

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

Measures for conservation and enhancement

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

B). The siting of industries requiring water diversion and large volume water withdrawals should be avoided in waters adjacent to surfclam and ocean quahog EFH. Project proponents should demonstrate that project implementation will not negatively affect

C). All NPDES permits should be reviewed and strictly enforced in surfclam and ocean quahog EFH.

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

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

2.2.5.14 Introduced species

Over the past two decades there has been an increase in introduction of exotic species into aquatic habitats (Kohler and Courtenay 1988). Introductions can be intentional (e.g., for purpose of stocking or pest control) or unintentional (e.g., fouling organisms). Five types of negative impacts generally occur due to species introductions: (1) habitat alteration; (2) trophic alteration; (3) gene pool alteration; (4) spatial alteration; and (5) introduction of diseases. Habitat alteration includes the excessive vegetation of introduced aquatic plants (e.g. hydrilla, watermilfoil, and alligator weed (Kohler and Courtenay 1986). This overgrowth interferes with swimming and fishing activities, upsets predator-prey relationships, and causes water quality problems. The introduction of exotic species may alter community structure by predation on native species (e.g. brown trout on brook trout) or by population explosions of the introduced species (e.g. tilapias). Spatial alteration occurs when territorial introduced species compete with native species (e.g. displacement of brook trout by brown trout). Although hybridization is rare, gene pool deterioration may occur between native and introduced species (e.g. brown trout and brook trout). One of the most severe threats to a native fish community is the bacteria, viruses, and parasites that can be introduced with exotic species (Kohler and Courtenay 1986).

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

Measures for conservation and enhancement

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

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

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

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

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

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

2.2.5.15 Cumulative impact analysis

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

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

Estuaries provide the nation with highly productive habitats and important living resources. Intensive use of these ecosystems for industrial, residential, and recreational activities has had cumulative adverse effects on many estuarine resources.

The Mid-Atlantic region extends from New York through North Carolina. However, Mid-Atlantic Fishery Management Council manages species throughout their range, which for surfclams and ocean quahogs includes Georges Bank through Capes H. The National Estuarine Inventory defines 15 estuaries in the Mid-Atlantic States including, Gardiner's Bay, Long Island Sound, Great South Bay, Hudson-Raritan Bay, Barnegat Bay, New Jersey Inland Bays, Delaware Bay, Delaware Inland Bays, Chincoteague Bay, Chesapeake Bay, Albemarele Sound, Pamlico Sound, Bogue Sound, New

River, and Cape Fear River (USDC 1990). Mid-Atlantic estuaries account for 44% of the total freshwater discharge to coastal waters along the Atlantic coast. Yearly precipitation amounts to 40 to 48 inches per year. However, peak freshwater flow is a result of spring snow melt (USDC 1990).

Human use of estuaries in the Mid-Atlantic is extensive and described earlier in section 2.2.5. These problems have begun to be addressed. However, conclusions about the cumulative effects of contaminants is lacking on the ecosystem and the marine waters that were established as surfclam and ocean quahog EFH, along with much of the North and Mid-Atlantic coast. Unquantified cumulative impacts have potential impacts to the sustainability of the surfclam and ocean quahog fishery.

2.2.5.15.1 Nutrient Loading

Land use intensification threatens efficient nutrient cycling in many watersheds. Excess nutrients from land based activities accumulate in the soil, pollute the atmosphere, pollute ground water, or move into streams. Healthy watersheds have a reasonable balance of nutrient imports and exports (Aschman *et al.* 1997). Physical characteristics and nutrient loadings of eight of the major mid-Atlantic estuaries are summarized in Table 17. Five of eight of these estuaries have medium to high nutrient loadings. Nutrient inputs include a combination of urban and industrial sources (Mid-Atlantic Regional Research Program 1994). Nutrient inputs to these mid-Atlantic estuaries include sewage input (septic systems and wastewater treatment), industrial wastewater, urban input, agricultural sources, and atmospheric inputs.

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

Measures for conservation and enhancement

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

2.2.5.15.2 Eutrophication

Nutrient inputs are known to have a direct effect on water quality. For example, in extreme conditions excess nutrients can stimulate excessive algal blooms that can lead to increased metabolism and turbidity, decreased dissolved oxygen, and changes in community structure, a condition called eutrophication (NOAA 1996, 1997a,b). Office of Ocean Resources Conservation and Assessment (ORCA) initiated the Estuarine Eutrophication Survey in 1992 to comprehensively assess the scale and scope of nutrient enrichment and eutrophication in the National Estuarine Inventory estuaries. Table 18 illustrates the results of the eutrophication survey for the Atlantic coast, collected through a series of surveys, interviews, and regional workshops. The surveys describe existing conditions and trends of 17 parameters that characterize nutrient enrichment (NOAA 1996, 1997a,b).

Measures for conservation and enhancement

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

2.2.5.15.3 Harmful algal blooms

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

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

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

The role of nutrients in algal blooms around the world is well documented (Hughes Commission 1997). *Pfiesteria* has a complicated life cycle (Figure 20), and the role that nutrients play in that life cycle is still unknown. Dr. Joanne Burkholder, who is credited with the discovery of *Pfiesteria*, has demonstrated in the laboratory that the growth of non-toxic stages of *Pfiesteria* can be stimulated by the addition of inorganic and organic nutrients. Field studies conducted by Burkholder have demonstrated a correlation between phosphorous-rich waste outfalls and high concentrations of non-toxic *Pfiesteria* (Hughes Commission 1997). It is important to note that not all outbreaks of *Pfiesteria* occurred in nutrient-enriched waters. Currently, it is not known what triggers *Pfiesteria* to a toxic stage. High nutrient concentrations are not required for *Pfiesteria* or *Pfiesteria*-like dinoflagellates to turn toxic. In fact, if suitable concentrations are present, toxic outbreaks can occur even if nutrient concentrations are relatively low. It appears that excessive nutrient loadings can help to create an environment rich in microbial prey and organic matter that *Pfiesteria* uses as a food supply (Hughes Commission 1997). Some scientists hypothesize that the primary stimuli for the transformation of the dinoflagellate into toxic stages are chemical cues secreted or excreted by the fish. In other words, fish must be present for a toxic outbreak to occur (Hughes Commission 1997).

Measures for conservation and enhancement

A). Federal and state agencies should address the issue of harmful algal blooms which cause adverse effects in surfclam EFH.

2.2.5.15.4 Wetland loss

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

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

Measures for conservation and enhancement

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

2.2.5.15.5 Global climate change

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

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

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

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

Measures for conservation and enhancement

While the following recommendations made by Bigford (1991) would improve the prospects of dealing effectively with global warming and sea level rise, they may also apply to climatic fluctuations as well.

A). Resource and land use planners should include physical, ecological, and economic impacts of rising waters with respect to fish habitat and the fishing industry on a short-term and long-term basis.

B). Local, regional, state, and federal agencies should accommodate sea level rise in decisions related to permits and federal support.

C). Responsible agencies should conduct studies, including engineering and ecological, on the implications of a range of sea levels on coastal ports and habitats.

2.2.5.16 Legislation and regulations that currently address habitat issues

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

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

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

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

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

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

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

Resources Subcommittees (LRSCs) of many of these estuaries recommending research needed to understand estuarine processes and problems, assisting in the development of CCMPs, and facilitating their implementation.

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

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

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

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

2.2.6 Prey species

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

In summary, surfclams and ocean quahogs are planktivorous siphon feeders therefore water quality is essential to the health of the stocks as well as their fitness for human consumption.

2.2.7 Research and Information Needs

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

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

The five sets of recommendations in this section are simply a compilation of all existing data needs. The Council stands ready to work with NMFS to prioritize these needs on a coastwide basis. The

Council is soliciting input from the public during the hearing process as to their view of prioritization.

The first set of recommendations comes from the Surfclam and Ocean Quahog Amendment 8 (MAFMC 1988). Where it is stated that the National Status and Trends Program of NOAA (USDC 1987) should assist in making intelligent decisions involving the use and allocation of resources in the nation's coastal and estuarine regions. These decisions require reliable and continuous information about the status and trends on environmental quality in the marine environment. Four general objectives have been established for the early years of the National Status and Trends Program (USDC 1987). Those objectives are: (1) to establish a national data base using state of the art sampling, preservation, and analysis methodologies; (2) to use the information in the data base to estimate environmental quality, to establish a statistical basis for detecting spatial and temporal change, and to identify areas of the nation that might benefit from more intensive study; (3) to seek and validate additional measurement techniques, especially those that describe a biological response to the presence of contaminants; and (4) to create a cryogenic, archival specimen bank containing environmental samples collected and preserved through techniques that will permit reliable analysis over a period of decades. While the Council concurs with these objectives, efforts by this program or other NMFS programs also must look at specific issues which include:

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

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

The second set of recommendations comes from Weissberger *et al.* (1998a and b) citing the following information is lacking on the biology of surfclams and ocean quahogs.

Surfclams

a) Obtain accurate estimates of population sizes. Continue efforts to refine estimates of population abundances in different regions, and to understand factors affecting dredge efficiency. In addition to assessment surveys, use depletion experiments by commercial vessels, complemented by quantitative techniques, to assess total population densities and age structure.

b) Determine the implications of density effects on growth and size for harvesting and optimal yield. Recent findings confirm earlier ones that high population density may negatively affect growth rate, size at age, and meat weight, but there is insufficient information to determine optimal densities for management purposes. Region-specific studies on the effects of population density on age-specific growth are needed.

c) Determine the genetic structure of populations of *Spisula solidissima* over the whole geographic range of the species. Use molecular techniques to determine the relationship between *S. solidissima*, the southern subspecies *S. s.similis*, and the named species *S. raveneli*, whose systematic status is uncertain. If the surfclam population were divided into independent genetic units, this would have important implications for management.

d) Examine the effects of dredging on settlement and recently-settled clams. While the effects of dredging on juvenile and adult clams have been studied, there are no data on the effects of dredging on the youngest clams. Because of their small size, settling and recently-settled clams may be adversely affected by dredging.

e) Carry out region-specific studies on the correlation between environmental parameters (e.g. bottom temperature), spawning, and recruitment. Physical data are often available from other research programs on the continental shelf which can be correlated with yearly changes in spawning times and subsequent settlement intensity and recruitment.

Ocean Quahogs

a) Obtain accurate estimates of population sizes. Because ocean quahogs may remain deeply burrowed for long periods of time, dredges may miss many clams in assessment studies. Consequently, the true population size is unknown. Consideration should be given to different gear efficiencies in different sediment types, and studies should be extended into deeper water in all regions. Sampling techniques other than hydraulic dredges should be used on an experimental basis.

b) Study recruitment of individuals to the population (patterns of settlement, early growth, and survival). Field data on the early life history phases of ocean quahogs are lacking. Incorporation of settlement and recruitment rates into population models would yield a more accurate picture of population dynamics.

c) Using regional or within-region differences in fishing intensity, study the effects of total closure (e.g., the ban due to PSP in quahogs from Georges Bank) or reduced fishing disturbance on settlement and recruitment.

d) More information on life history (growth, spawning cues) is needed from the southern part of the range (south of NJ) and from deeper waters. Samples from the commercial catch can be used to obtain better estimates of size-specific meat weights and spawning times in different regions. These data can be correlated with real-time environmental data available from satellites, sub-surface observing systems on the continental shelf, and sensors placed on board commercial vessels.

e) Determine the genetic structure of the ocean quahog resource over its entire range. Present models and management plans assume that the larval stage is long enough that all populations are linked, but the marked life history differences in the inshore Maine population suggest that this is not likely over all spatial scales. If spawning times vary on a regional basis, and spawning is spread over a considerable part of the year in some populations, certain populations may act as larval sources at one time of the year and not at others, depending on seasonal changes in hydrographic regimes. Molecular techniques would be extremely useful in determining genetic structure.

The third set of research recommendations come from the surfclam SARC (NEFSC 1998a) and include:

<u>Dredge Improvements</u>

a) For future research vessel surveys, a faster winch (perhaps including a free-spool option, if feasible) needs to be employed aboard the *Delaware II*. Slow pay-out and retrieval rates of the current winch result in excessive bottom contact outside of the 'nominal' tow time, which increases uncertainty in the length of the tow path. A faster winch would also improve the ability to conduct depletion-type experiments.

b) New sensors monitoring dredge performance (inclination, pump pressure, bottom contact, etc.) were incorporated into the 1997 survey. These data allowed for accurate standardization of tow path length. Currently, information from these sensors must be downloaded every few tows and multiple clocks are in use for different sensors. It is strongly recommended that the collection and archiving of this information be fully integrated with the shipboard computing system on *Delaware II* and that only a single master clock be used. This will speed data collection and quality.

c) Incorporation of coaxial or standard monitoring cable into the dredge power supply would establish a real-time link to monitor dredge performance, perhaps to include video, pressure, amperage, and bottom contact. This link could improve the standardization of dredge hauls.

d) Sampling effort could be more precisely controlled by the use of a movable dredge knife carrier which could be deployed remotely when the dredge is intended to fish. Such a scheme could virtually eliminate the 'shoulder' effect of continued sampling outside the nominal survey tow time.

e) New sensors aboard the *Delaware II* clam dredge allow for monitoring of tow path length by integrating the velocity of the ship (measured from GPS), multiplied by dredge contact/non-contact, as indicated by the inclinometer. A more direct approach would be to incorporate a mechanical or electronic odometer directly on the dredge. This device could monitor speed and distance in real time, if the second recommendation above were adopted.

Research Survey Design and Analysis

f) Annual surplus production is approximately zero in the major region that has supported the fishery throughout the 1990s (Northern New Jersey). This calculation is sensitive to the assumption of the natural mortality rate, which is poorly known. In order to assure adequate monitoring of the resource to meet management needs, fished portions of the resource need to be monitored via research vessel surveys at a frequency of every second year. Non-fished areas could be monitored less frequently as long as risk-averse management strategies for these portions of the resource are implemented.

g) Precision in survey abundance indices and monitoring of interannual changes in dredge performance could potentially be enhanced with a survey strategy that incorporates a sub-set of fixed stations, with a partial replacement design. A full fixed-station design is not warranted, however, given changes in the spatial distribution of recruits and the fishery.

h) Calculations of stock biomass are based on the stratified random design, with fixed stratum areas. Although this procedure results in a relatively precise estimate for major portions of the resource (New Jersey and Delmarva), alternative integrated biomass estimation methods should be considered (e.g., geostatistical techniques such as kriging or Theissen polygon or other weighting of sampling points).

I) One potential source of bias in the swept-area calculations is the estimated stratum areas. These areas were derived several years ago. More accurate computerized methods (e.g., GIS) have become available. As the stratum areas proportionally influence the biomass calculations, these areas should be reviewed, and updated, as appropriate.

j) Potential biases in the swept-area estimates arise when portions of the survey strata include habitat which is either not suitable for the target animal or cannot be sampled (e.g., too rough). This situation occurs for surfclams primarily on Georges Bank and in Southern New England.

Bottom topography information, as well as the historical records of successful dredge hauls should be used to establish the portions of affected survey strata which should be eliminated from consideration in the stratum area weighting coefficients.

k) Depletion experiments aboard the *Delaware II* and commercial vessels were an effective and efficient method to derive usable estimates of dredge efficiency. Because of the potential for interannual variation in survey dredge performance, additional depletion experiments (at some level) should be incorporated as a component of future surveys. Sites depleted by the *Delaware II* could be cross-validated by additional work with commercial vessels.

Biological Parameters

l) The current assessment assumes a nominal natural mortality rate (M) = 0.05. By inference, this rate implies that, if not fished, 5% of the animals should survive to age 60. This conflicts with the aging information which has documented few animals older than age 30, even in areas not subjected to massive die-offs in 1976. Given the sensitivity of net productivity, DeLury population estimates, and YPR calculations to M, additional studies to refine the assumed M are considered a high priority. Better estimates of M could be derived by making more complete use of historical ageing information, as well as from field and laboratory studies (mark-recapture experiments, shell biochemical studies, clapper/live animal ratios, 'longevity' of clappers).

m) Fishing mortality associated with animals that are not landed is potentially important in the surfclam assessment. Non-landings mortalities potentially arise from 1) animals damaged by the gear on the bottom, but not retained in the dredge, 2) animals in the vicinity of dredging that may be killed by release of sulfides or localized dissolved oxygen depletions, 3) animals which go through the sorting machines and are discarded dead, and 4) animals which are broken and retained in the sorting machines, but which are then sorted overboard by hand (e.g., for supplying to the 'hand shucked' market). Additional sea sampling combined with specific *in situ* studies are needed to estimate non-landings mortality.

n) Seasonal change in condition factors of surfclams can be great, owing to changes in soft tissue mass associated with spawning and feeding. Monitoring of changes in condition are important in estimating numbers of clams that are removed from the population, since the quota is established in volume-weight units (bushels converted from meat weight). More intensive monitoring of meat weights, including cooperative sampling with industry, is recommended. As part of this research, implications of variations in environmental conditions on meat yields could result in a predictive capability, of use to industry.

o) Magnitude and variability of recruitment is a key component in assessing sustainable harvest strategies. Additional research should be conducted to estimate relative and absolute recruitment (e.g., from swept-area estimates).

Potential Density Dependence of Condition Factor and Growth

p) Evaluation of available evidence for density-dependent growth and condition in the Delmarva region suggested that additional studies are needed. Gradient sampling of age/length/weight, clam density, and environmental factors is necessary to establish and rank the importance of biotic and abiotic factors. Studies of clam production in relation to intraspecific density, chlorophyll flux, and other environmental factors are appropriate.

Research with Industry

q) Progress in addressing several critical elements of this assessment was facilitated by direct cooperation by industry. Additional high priority projects could be undertaken in further such efforts. In particular, additional depletion-type experiments and seasonal/spatial sampling for variations in meat weight could be undertaken.

r) There is a priority need for an intensive review of logbook data collection, data transcription, and interpretation of results, which could be undertaken with the assistance of vessel captains and owners. In particular, NMFS should record in computer data bases the location fished in as fine a resolution as is recorded in the logbooks. More precise location data from historical logbook submissions, especially those collected after 1990, should be re-entered into the NMFS database.

SARC Research Recommendations

s) Compute the magnitude of the bias in the estimated dredge efficiencies and correct any parameters that are functions of efficiency (e.g., current and projected biomass).

t) Work toward developing a multi-index based, population model for estimating biomass and fishing mortality rate that incorporates a time series of survey and commercial abundance indices.

u) Estimate reference points required for satisfying the 1997 SFA guidelines.

v) Determine whether there is a relationship between survey catch per tow and other variables (i.e., pump pressure, depth).

The fourth set of research recommendations come from the ocean quahog SARC (USDC 1998b) and include:

a) Studies are needed to determine whether reduced clam density, resulting from harvesting, has an impact on fertilization rate. In particular, at what density does the probability of reproductive success decline. Studies are needed to determine if area closures would reduce the risk of reduced fertilization rates in fished areas. The impact of harvesting on larval recruitment and juvenile survival should also be investigated.

b) The most important need for the 1999 survey is to expand the area surveyed. New areas requiring surveying are of three types:

1) Because of the sensitivity of the stock assessment and quota-setting process on the total quahog biomass present, it is essential to include as much of the biomass as possible within the survey. In order to do this, the survey needs to be extended to the 60-fathom contour from Cape Hatteras to Georges Bank. Extending the survey to 50 fathoms would be a distinct improvement.

2) Some strata in shallower water (42, 43) have not been sampled because they contain mud, but there are data suggesting that ocean quahogs are present and may be exploited in those areas. Stratum 63 on GBK should also be sampled.

3) Although this report targets ocean quahogs, the Invertebrate Working Group earlier also identified a need to increase the sampling of surfclams off northern New Jersey to obtain a better estimate of density in fished areas.

c) In order to sample to 60 fathoms, survey gear will need to be modified. The pump housing will have to be modified to withstand more pressure. The power cable will have to be extended to tow in 60 fathoms, and will require the purchase of a new, longer power cable.

d) The rate of deployment and retrieval of the dredge has proven to be a critical variable in calculating abundance because it introduces a bias into the estimate of the area swept by the dredge. In some cases, the present winch has increased the area swept by an estimated factor of 2 because of the slowness of deployment and retrieval. Therefore, a winch capable of a much more rapid rate of deployment and retrieval is essential to minimize the errors associated with the calculation of the area swept by the dredge.

e) Calibration of dredge efficiency has proven to be extremely useful for calculating abundance from both the 1997 surfclam and ocean quahog surveys. The 1999 survey must be similarly calibrated. Dredge efficiency was obtained in two ways in 1997. The R/V *Delaware II* conducted one experiment by itself. In addition, in 1997, the *Delaware II* "set-up" a series of industry depletion experiments by making 8 standard tows in an area to characterize abundance; this was followed by an industry vessel conducting a depletion experiment at that site to measure true abundance. The 1999 survey should include both of these steps again.

f) There is a need to include some fixed stations in the survey, perhaps 20% of the sites. Fixed stations permit a direct comparison between surveys to provide more confidence in the comparisons required from one survey to the next. These fixed stations should be of two types. On Georges Bank, they should be chosen for repeated sampling from one survey to the next. Elsewhere, a certain number of stations should be chosen from the previous two surveys for re-sampling. This was done in 1997 for comparison with 1992 and 1994 and was very successful.

g) The 1997 survey included a number of dredge performance sensors which provided extremely valuable data. However, retrieving the data from each of these individual sensors added a significant complexity to post-deployment processing, and the need to calibrate a number of independent clocks proved to be a difficult process. To the extent possible, the data sensor system should be integrated in such a way as to minimize the number of independent clocks and minimize the time required interrogating sensors after each haul.

h) To accomplish these addition tasks, there is a need to expand the 1999 survey time slot. Realistically, recognizing the need for additional sampling, the need to sample the deeper stations last to minimize the chances of dredge pump failure compromising the survey, and the time required for depletion set-ups, expansion of the planned 6-week mission to 8 weeks is strongly recommended.

I) Size selectivity of the survey dredge for surfclams and ocean quahogs is uncertain and needs to be estimated. The effect of clogging by shells and debris within the dredge should be considered.

j) Additional work is needed to determine the contribution of each region to recruitment across geographical regions.

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

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

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

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

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

2.2.8 Review and Revision of EFH Components of FMP

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

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

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

The Council envisions creating a Habitat Monitoring Committee (HMC) made up of at least staff representatives from the NMFS Northeast Fisheries Science Center, the Northeast Regional Office Management and Habitat Sections, the Atlantic States Marine Fisheries Commission, and Chaired by the Council Executive Director or his/her designee. The HMC will meet at the call of the HMC Chair, to develop options for MAFMC consideration on any adjustment or elaboration of any FMP EFH definition or gear impacts of EFH recommendations necessary to achieve the habitat goals and objectives. Based on this review, the HMC will recommend specific measures to revise EFH definitions, revise gear specifications.

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

2.3 DESCRIPTION OF FISHING ACTIVITIES

2.3.1 Surfclam Fishing Activities -- The following information is taken mainly from SARC 26. The SARC generally expresses their measurements in metric (i.e. kilograms). This text has been changed to reflect English units (i.e. pounds), however the Tables and Figures are generally still in metric units.

Commercial landings and effort data from 1982 to 1997 (partial year) are from mandatory vessel logbooks. It is assumed throughout this assessment that one bushel of surfclams = 17 pounds = 7.7 kg of usable meats. Parameters relating shell length to meat weight are from Serchuk and Murawski (1980), are region specific, and were based on samples obtained in the winter. Revised length/weight information were collected during the summer 1997 resource survey aboard the R/V *Delaware II*. Vessel size class categories are: Class 1 (small, 1-50 GRT), Class 2 (medium, 51-104 GRT), and Class 3 (large, 105+ GRT). Commercial length frequencies were estimated by region from port agent sampling.

2.3.1.1 Landings

Between 1965 and 1974, total landings rose from 44 million to 97 million pounds of meats (Figure 10). After 1974, total landings declined steadily to 35 million pounds in 1978. Major recruitment of surfclams in the Mid-Atlantic region from Delmarva through New Jersey in the late 1970s resulted in increased landings throughout the early 1980s. Annual EEZ quotas have been set since 1978. Between 1983 and 1997, annual EEZ landings have been fairly constant, ranging from 44 million to 55 million pounds of meats. In the 1980s, approximately 75% of the landings were from the EEZ; the remainder were taken from state waters. In the 1990s, the percentage of landings from the EEZ has decreased slightly to approximately 70%. EEZ landings have typically been very close to the annual quota.

Since 1994, virtually all of the EEZ landings have been taken from the Mid-Atlantic region. In the period between 1986 and 1997, 74-91% of the Mid-Atlantic landings came from Northern New Jersey, 5-16% came from Delmarva, and 0-10% came from Southern New Jersey (Figure 3). This represents a shift away from the Delmarva region which had been a major location for landing surf-clams in the late 1970s and to a lesser degree in the early 1980s. In recent years, the fishery is currently focused off the coast of New Jersey (Figures 21 and 22).

2.3.1.2 Landings/Effort

In the early 1980s, similar high annual efforts of 15,000 - 16,000 hrs were being exerted in Delmarva and Northern New Jersey (Figure 23). Effort subsequently declined in Delmarva, but remained high in Northern New Jersey. From 1985 to 1990, reported hours fishing per year in each area were well below levels of the early 1980s. Hourly trip limits were in effect during this period. Since 1991, effort has risen modestly, reflecting declining LPUE over this period (see below).

Nominal trends: In the Mid-Atlantic region, typically >80% of the annual surfclam catch is taken by large (105+ GRT) vessels (NEFSC 1998a). In the Northern New Jersey area, LPUE peaked for all vessel size classes in 1986, and has since declined (Figure 4). Since 1991 (after the period of effort regulation), LPUE has decreased from 2,344 pounds/hour to 1,642 pounds/ hour (1,063 kg/hr to 745 kg/hr) (-30%) for vessel class 3, -40% (1995-1997) for class 2, and has varied without trend for the few class 1 trips.

Off Southern New Jersey, class 3 nominal LPUE declined from 4,428 pounds/hour (2,008 kg/hr) in 1992 to 1,707 pounds/hour (774 kg/hr) in 1997 (-61%). Class 2 LPUE declined 79% between 1993 and 1997, while class 1 LPUE again varied without trend.

In the Delmarva area, LPUE since 1991 has varied widely, primarily reflecting the few number of vessel trips taken in the region. Indices have since tended downward for classes 3 and 2.

General linear models: GLMs were carried out, by region (NEFSC 1998a), on the natural log of LPUE to obtain a standardized abundance index from the commercial data. For Northern New Jersey (NNJ) and Delmarva (DMV), year, vessel ton class, and subregions were included as explanatory variables. "Subregions" were created by partitioning the NNJ and DMV regions into approximate halves.

GLM results from NNJ and DMV are most important because the fishery is active in these areas, and NMFS research surveys have indicated that these areas contain the majority of the stock biomass. The standardized LPUEs follow the nominal LPUEs of large vessels rather closely, indicating an approximate 30% decrease in LPUE since 1991 off NNJ and a sharp decline off DMV since 1994 (NEFSC 1998a).

Effort reporting problems prior to 1991 confound the interpretation of LPUE as a consistent measure of relative resource abundance over the whole time series (1980-1997). Nevertheless, the rapid rise in LPUE in NNJ and DMV is consistent with improving resource conditions in the mid 1980s, peaking in the late 1980s-early 1990s. Modest declines in LPUE in recent years (e.g., 1991 onward) off NNJ are probably indicative of changes in the abundance of the stock, since virtually all of the resource is within the zone of coverage by the fishery (see following sections).

2.3.1.3 Size Composition

Length frequency distributions for surfclams landed between 1982 and 1996 are presented for the New Jersey and Delmarva regions in Figures 24 and 25, respectively. Between 1982 and 1990, the average size of clams landed from Southern New England (approximately 5.9 - 6.3 inches) was greater than that from areas to the south (typically 4.7 - 5.5 inches). No data are available from Southern New England after 1990. Mean length of clams landed from the Delmarva area has decreased steadily from 6.3 inches in 1982 to 4.9 inches in 1997. Small clams sampled in 1994 are probably more indicative of poor sampling effort since size distributions in 1995 and 1996 were similar to those in 1991-1993.

Mean length of clams landed from the New Jersey area has remained relatively steady throughout this period (5.4 - 5.7 inches), although the percentage of small clams (3.5 - 4.3 inches) taken has increased since 1993. The proportion of clams in the 5.9 - 6.3 inch category increased beginning in 1991 off NNJ and has remained high since then.

The following descriptive information was developed mainly for the 1999 quota recommendations to the Regional Administrator. Most of the weights in the quota paper are expressed as bushels because that is what industry generally works in and thus most of the Tables are in bushels rather than pounds.

Coastwide landings of surfclams totaled 3.32 million bushels (56.5 million pounds) in 1997, a decrease of 11.2% from the 3.74 million bushels (63.6 million pounds) landed in 1996 (Table 19). Reported exvessel value declined 11.6% from $38.27 million to $33.82 million dollars. As opposed to landings declines which have occurred in prior years, the current reduction is not due to the lowering of either federal or state quotas, nor a decline in the health or availability of surfclam populations. All indications point to difficulties experienced by the processing sector in selling products containing surfclams in quantities comparable to prior years. Without orders from processors to purchase surfclam shell stock, fishermen in turn reduce their harvests.

In recent years, surfclams have been harvested from four different jurisdictional areas: the federal EEZ, and the state waters of New Jersey, New York, and Massachusetts. All but Massachusetts have established management regimes which include annual quotas and harvest limits for individual vessels. For the most recent year of 1997, none of the fisheries with quotas caught their allotted amount, and the Massachusetts landings fell to zero.

2.3.1.4 New Jersey Inshore

New Jersey manages the largest state fishery for surfclams, with an annual quota of 600,000 bushels (10.2 million pounds) that has been held constant for several years. New Jersey is unique, however, in defining a season which begins in October of one calendar year and closes at the end of May in the next. Many vessels in the New Jersey inshore fishery for surfclams also participate in the federal fishery. For each of the past two seasons, 22% of the New Jersey quota was left unharvested on the ocean floor (Table 20).

2.3.1.5 New York Inshore

New York inshore waters are divided into two segments: Long Island Sound and Atlantic Ocean inshore waters. While there are approximately 100 permits for the Long Island Sound area, the quantity of surfclams landed from that area is very small. With attractive shells of a golden-brown color, these surfclams are often harvested by hand, and sold fresh into sushi and premium bait markets.

The vast majority of New York inshore harvests are from the Atlantic Ocean area, for which there are currently 22 moratorium vessel permits, held by 15 owners (Fox pers. comm.). When a moratorium and quota management were instituted in 1994, there were a total of 25 moratorium vessel permits issued. Three of these permits were canceled at the end of 1995 for failing to meet the minimum harvest requirement of 5,000 bushels per year.

The average catch from New York waters was approximately 173,000 bushels annually for the 20-year period spanning the 1970's and 1980's. Catches soared in 1990 with implementation of ITQ management in the federal surfclam fishery, and surplus vessels sought alternative areas to fish.

Harvests peaked in 1993 at just over 850,000 bushels for the year (Table 21), and have trended downwards since. With the apparently shrinking market for surfclams, the black, lower-yielding resource off New York's Atlantic coast has most strongly felt the effects. As of July 1998, half of the 22 vessel fleet has been idled for the past six months (Fox pers. comm.).

A comparison of the landings for the first half of each year (Table 22) since 1994 indicates that the significant unemployment currently being experienced by the New York fleet is not a seasonal phenomenon. Landings in 1998 are down by almost 40 percent from the same period in 1997.

As of late July 1998, only the three vessels fishing for the small, vertically-integrated Doxsee plant are still actively fishing.

In recognition of the difficulty which fishermen are having in finding a market this year, the State of New York is planning on waiving the 5,000 bushel minimum harvest requirement (in order to maintain a moratorium permit) for 1998, and perhaps beyond if circumstances warrant.

2.3.1.6 Federal Surfclam Fishery

The federal fishery for surfclams was conducted by a total of 33 vessels in 1997, a decrease of one vessel from the number participating in 1996 (Table 23). Relative to the 128 vessels reporting harvests of surfclams at the initiation of the ITQ program in 1990, this represents a 74% reduction in this sector of the fleet. Effort was spread across 2,119 individual trips, harvesting an average 1,139 bushels (35.6 cages) per trip. The harvest of surfclams from federal waters totaled 2.414 million bushels (41.0 million pounds) in 1997, falling 6% short of the 2.565 million bushels (43.6 million pounds) quota.

2.3.1.7 Recreational or Party and Charter Fisheries

There are no recreational or party and charter fisheries for surfclams and therefore no need to address these sectors or any animals released alive from these fisheries.

2.3.2 Ocean Quahog Fishing Activities -- The following information is taken mainly from SARC 27. The SARC generally expresses their measurements in metric (i.e. kilograms). This text has been changed to reflect English units (i.e. pounds), however the Tables and Figures are generally still in metric units.

Commercial landings and effort data from 1980 to 1997 are from mandatory vessel logbooks. It is assumed throughout this assessment that one bushel of surfclams = 10 lbs = 4.5 kg of usable meats. Parameters relating shell length to meat weight are from Murawski and Serchuk (1979), are region specific, and were based on samples obtained in winter. Revised length-weight information was collected during the summer 1997 resource survey aboard the R/V *Delaware II*. Vessel size class categories are: Class 1 (small, 1-50 GRT), Class 2 (medium, 51-104 GRT), and Class 3 (large, 105+ GRT). Commercial length frequencies were estimated by region from port agent sampling.

2.3.2.1 Landings

The ocean quahog fishery was in its early stage between 1967 and 1975 when total landings were less that 2 million pounds of meats per year (NEFSC 1998b). The period from 1976 to 1984 was a transition from low to high catches. Since 1985, 44 to 53 million pounds of meats have been harvested annually, with 90-100% of those landings from the EEZ.

Annual EEZ quotas have been set since 1978. Between 1986 and 1994, the quota was well above the annual catch. The EEZ quota was reduced each year from 1995 to 1997, and in 1997 the entire quota was taken.

Through time, the fishery has moved from south to north (NEFSC 1998b). There were multiple reasons for the movement. One set of reasons is related to cost and efficiency of operating a processing plant. These include relocation of plants to sites with deepwater piers, cheaper freight, and fewer problems with disposal of waste water. Another set of reasons is related to the relative abundance of clams in the south and north and the proximity of those clam beds to shore.

The movement of the fishery over time is reflected in the pattern of landings. Regions with the most landings by period include New Jersey during 1978-1986, Delmarva 1987-1988, New Jersey 1989-1991, Long Island 1992-1995, and Southern New England 1996-1997 (NEFSC 1998b). Maps of cumulative ocean quahog catch during 1980-1985, 1980-1989, 1980-1993, and 1980-1997 show the northeastward migration of the fishery through time (Figure 2). No landings have been reported from east of 69°N latitude because Georges Bank has been closed since 1990 due to the risk of paralytic shellfish poisoning (PSP).

2.3.2.2 Catch per Unit Effort (CPUE)

In general, the regional trends in fishing effort (i.e., hours fished) over time are similar to trends in landings over time (NEFSC 1998b). In 1996-1997, total fishing time in Southern New England was greater than in any other region. Before 1995, there was very little fishing effort in Southern New England. In 1995, maximum hours fishing took place in the Long Island region. Before 1995, fishing effort was always greatest in the New Jersey and Delmarva regions.

From 1994 to 1997, there has been a decline in total fishing effort (Southern New England to Southern Virginia/North Carolina). This is at least partially explained by recent reductions in the quota. It is probably also explained by the high catch rates off Southern New England where most of the harvesting now occurs.

Nominal trends by region: From Southern New England to Southern Virginia/North Carolina, typically >80% of the annual catch is taken by large (105+ GRT) vessels (NEFSC 1998b). For New Jersey and Delmarva, the regions that have been fished the longest, CPUE of large vessels has declined over time. For example, CPUE in Delmarva was 660 - 1,010 pounds/hr during 1980-1982, 1,320 - 1,430 pounds/hr during 1983-1987, and 1,450 - 1,675 pounds/hr during 1990-1997 (NEFSC 1998b). The same pattern is seen for New Jersey, although CPUE did increase in 1996-1997. A detailed spatial analysis of landings revealed that this increase resulted from movement by a few fishermen to deeper areas further offshore which were not exploited previously.

The Long Island and Southern New England regions have been harvested for relatively short periods of time. Since 1992, when effort increased dramatically in the Long Island region, CPUE peaked at 1,920 pounds/hr and then declined to 1,320 - 1,430 pounds/hr during 1993-1997. Southern New England has only been fished intensively since 1995, and CPUE has been high at 1,430 - 1,570 pounds/hr.

Changes in CPUE over time for all regions south and west of Georges Bank are shown in Figure 6. This demonstrates a decline over time in CPUE in the Delmarva and New Jersey regions. It also shows the movement of the fishery to Long Island and Southern New England, where current catch rates are higher than in more southern regions.

General linear models (GLM) by region: A separate GLM was carried out for each region(NEFSC 1998b) on the natural log of CPUE to obtain a standardized abundance index from the commercial data. Year, vessel ton class, and subregions were included as explanatory variables. "Subregions" were created by partitioning each region into approximate halves.

Estimates of the coefficients for the year parameter are indicative of CPUE over time for that region. The bias-corrected, back-transformed coefficients are plotted in Figure 26 for three regions. There appears to be a strong correlation between nominal CPUE from large vessels and the GLM standardized CPUE, which includes all vessels. This is not surprising given that large vessels dominate the fishery.

Declines in CPUE off New Jersey and Delmarva probably represent changes in the abundance of the stock in the areas that have been historically fished. CPUE is not likely to increase in these two regions in the future unless dense clam beds are discovered in deeper waters. There is already evidence of such movement to deeper water off New Jersey. New beds are less likely to be found off the Delmarva region because the continental slope is steep beyond 300 feet. In contrast, there are broad regions of continental shelf in the 250 - 350 feet range off the coasts of New Jersey, Long Island, and Southern New England. Depths greater than 250 feet have not been included on a regular basis as part of the NMFS clam surveys.

Nominal trends by 10-minute square (TNMS): CPUE was also examined using a smaller spatial unit, the TNMS. Given that ocean quahogs are sedentary and have a slow rate of growth, each TNMS can be considered to have had its maximum stock biomass before harvesting began. If each year of harvesting reduces the resource in the TNMS, then there should be a negative relationship between CPUE and total years of harvesting ("Fishing Year"). This was examined for nine TNMSs located from east of Long Island to the Delmarva region. The five squares from the south had a long history of harvesting compared with those from the north. A plot of the data support the model that biomass declines within TNMSs as the years of fishing increase (NEFSC 1998b). The data were then partitioning into three groups based on years of fishing: 1-4 ("Early"), 5-10 ("Mid"), and ≥11 ("Late"). Catch per unit effort declines across groups from "Early" to "Mid" to "Late" (Figure 27).

2.3.2.3 Size Composition of Landings by Region

Length frequency distributions for ocean quahogs landed between 1982 and 1997 are presented for the Southern New England, Long Island, New Jersey, and Delmarva regions in Figures 28 - 31, respectively. Between 1982 and 1997, average length of clams landed from New Jersey (approximately 3.5 - 3.7 inches) was greater than that from other areas (typically 3.1 - 3.5 inches). Mean length of clams landed from the Delmarva region has decreased steadily from 3.6 inches in 1994 to 3.3 inches in 1997. Mean length of clams landed from the New Jersey and Long Island regions has remained relatively steady. Although mean shell size from the Southern New England landings declined in 1997, this was due to targeting of specific beds with high meat yield and does not represent a shift in mean shell size of the exploited stock throughout that region.

The following descriptive information was developed for the 1999 quota recommendations to the Regional Administrator. Most of the weights in the quota paper are expressed as bushels because that is what industry generally works in and thus the Tables are in bushels rather than pounds.

Landings of ocean quahogs from the high-volume fishery outside the State of Maine totaled 4.3 million bushels (43 million pounds) in 1997, a decrease of almost 7% from the prior year (Table 24). A portion of the reduction is due to the federal quota for ocean quahogs being reduced by 3% in 1997, and the remainder to a drop in landings from Massachusetts State waters. Reported gross sales declined 6.6% from just over $19 million dollars to $17.78 million in 1997.

In stark contrast to the surfclam component of this industry, the federal ocean quahog quota is now binding on the industry, with 99% harvested in both 1996 and 1997. Since there are not significant resources available from state waters, the fleet does not have the additional options which exist in the sources of surfclam supply.

A total of 31 vessels participated in the 1997 fishery for ocean quahogs in federal waters apart from Maine. This represents a surprising drop of 14% from the 36 vessels which were harvesting in 1996 (Table 25). Federal ocean quahog vessel numbers had been stable at 36 for the prior four years, back to 1993. Effort was comprised of 2,294 individual trips, which harvested and average 1,865 bushels (58.3 cages) per trip. A fleet-wide calculation of Landings Per Unit of Effort showed that the average yield declined by 5% in 1997, from 133 bushels per hour of fishing to 126 (Table 25). The Maine ocean quahog fishery was brought under federal management in May 1998, however it was run consistently as an experimental fishery between 1991 and 1997. The annual landings, vessels, effort, etc. for the experimental fishery are presented in Table 26.

2.3.2.4 Recreational or Party and Charter Fisheries

There are no recreational or party and charter fisheries for ocean quahogs and therefore no need to address these sectors or any animals released alive from these fisheries.

2.3.3 Port and Community Description

Landings data collected by the National Marine Fisheries Service for the year 1997 identified a total of 27 ports (or port groupings) where surfclams or ocean quahogs were brought to shore. The six states in which the landings took place are: Maine, Massachusetts, Rhode Island, New York, New Jersey, and Maryland.

Federal confidentiality requirements prohibit the release of landings or value data for those locations which contain fewer than three vessels owners or processors, in order to safeguard proprietary business information. Unfortunately, the surfclam and ocean quahog industry has a relatively small number of processing plants, such that there may only be a single processing entity in an entire state. Therefore, much of the landings information for the industry must be aggregated above the port level before it can be published.

However, it is possible to provide an indication of the relative importance which the surfclam and ocean quahog fishery represents to a coastal community through a ranking of individual port's landings, and publishing the numbers of trips and vessels which landed there (Table 27).

Atlantic City, New Jersey was by far the most important port for the industry, with landed weight almost double that of the second-ranked port, New Bedford, Massachusetts. With four of the top ten ports located in New Jersey, the state stands out as being the most critical to the surfclam and ocean quahog industry as a whole. The McCay *et al.* report (1993) is the best available data for description of port and community involvement and in fact is the only systematic coastwide description currently available.

Maine stands apart from all other states in several regards. First, its portion of the fishery is made up almost entirely of ocean quahogs. Second, rather than harvesting larger individuals (approximately 3 inches in length) and processing them into chopped meats for chowders and sauces, the Maine fishery targets smaller individuals (between 1.5 and 2.5 inches) and sells them into the fresh, half-shell market.

The best information currently available on Maine port communities and the ocean quahog fishery as it is prosecuted there was compiled in Amendment 10 to the Surfclam and Ocean quahog FMP. The following sections were excerpted from Amendment 10, and readers are encouraged to obtain the original document if they wish further information.

2.3.3.1 Maine Fishery for Ocean Quahogs

There are between 33 and 53 boats participating in the ocean quahog fishery off of Maine in any given year. In 1996, 82 boats held a federal permit which allows them to participate in the experimental fishery. Of all the vessels that participate in the eastern Maine ocean quahog fishery, there are no more than a dozen year-round participants. The rest fish for market peak periods such as Memorial Day, 4th of July, and Labor Day. When those boats are not fishing for ocean quahogs, they target other species such as: sea scallops, lobster, sea urchins, and groundfish among others (Finlayson pers. comm.).

According to unpublished NMFS logbook data there were 43 vessels participating in the ocean quahog experimental fishery in Maine in 1996. A total of 69,067 bushels of ocean quahogs were reported landed in 1996. This represented an increase of 18,596 bushels (36%) from the 1995 level of 50,471 bushels. The average price of a bushel of ocean quahogs was $28.85 in 1996 (but prices have been as high as $45.00 per bushel in 1991). This represented a decrease of about $5 (15%) from the 1995 average. The decrease in price of ocean quahogs was likely caused by the increase in quahog landings from 1995 to 1996. In addition to this, landings of hardclams (Mercenaria mercenaria) which compete for market share with eastern Maine ocean quahogs has also increased in recent years (Finlayson pers. comm.). This last factor has likely affected the price of ocean quahogs in an inverse way. Monthly landings show that this fishery is highly seasonal, with more than 90% of harvests occurring between April and September on average.

Ninety percent of the eastern Maine ocean quahog's landings are in Washington County, Maine. Jonesport accounts for the largest percent of the total ocean quahog's landings, thus, being the most active port in the region (Finlayson pers. comm.). Socioeconomic indicators show that Washington county is among the more severely depressed areas in the Northeast United States (MAFMC 1998). In 1990, 91% of the population of Washington County was classified as residing in rural areas; 22% did not attain a high school diploma. The area is economically depressed with per capita income of $9,607 and a median household income of $19,993. Approximately 19% of the population lives below poverty level. To gain a clearer perspective on the state of the economy in Washington County, consider that in neighboring Hancock County per capita income is approximately 25% higher at $12,347 with only 10% of the population living below the poverty level. The unemployment rate in Washington County was 10.3% in 1990 (MAFMC 1998). More recent employment statistics show that as of December 1996 the unemployment rate (not seasonally adjusted) in Washington County was 7.5% (Finlayson pers. comm.).

2.3.3.1.1 Washington and Hancock County Demographics

Maine ocean quahogs are landed in Maine's two most easterly coastal counties (Hancock and Washington) with the Washington county landings exceeding those in Hancock county by an average of roughly 10 to 1. Hancock county includes some of Maine's most popular tourist destinations such as Acadia National Park. It also contains towns such as Castile, Blue Hill and Bar Harbor which are noted for their high proportion of wealthy residents. The town of Bucksport is home to a large paper mill employing over 1,000 workers at wages far above the state average.

Washington county, in contrast, enjoys none of these advantages. These and other contrasts are reflected in the following demographic statistics which help to explain why the employment and income from fishing is far more important to the welfare of Washington county coastal communities than to other areas of Maine.

Jonesport is the primary port of landing for the fishery. Ocean quahogs also are landed in the adjacent towns of Machias and Cutler to the north and Addison, Harrington, Milbridge, Steuben and Gouldsboro to the south. Jonesport is the archetypical fishing-dependent community (Finlayson pers. comm.). The only other source of primary economic activity is a small Coast Guard station. All of the local purveyors of goods and services are crucially dependent upon the income generated by the fishing industry. Lobsters lead the way in value followed by sea urchins, scallops, quahogs, other shellfish, mussels, finfish, marine worms and seaweed.

The demographics of Washington and Hancock Counties are significantly different (Table 28) with Hancock being more similar to Maine's overall average. These data are derived from both the U.S. Census and statistics compiled by the Maine State Planning Office.

2.3.3.1.2 Ports to the South of Maine

The best information currently available on port communities which land surfclams and ocean quahogs to the south of Maine is in a report prepared by McCay *et al.* in 1993. "Report, Part 2, Phase I, Fishery Impact Management Project, to the Mid-Atlantic Fishery Management Council,"describes the people and communities involved in fisheries ranging from Chatham, Massachusetts to Wanchese, North Carolina. The following sections represent excerpts from that work.

2.3.3.2 Massachusetts

2.3.3.2.1 New Bedford

In 1992 the total value landed in New Bedford was over $150 million, of which 60% came from sea scallops. In addition to scallops, yellowtail flounder, winter flounder, cod and other groundfish make up the bulk of landings in New Bedford.

There are approximately 300 boats in New Bedford. Thirty to 40 are small draggers in the 45-65 foot range, 120 are large draggers in the 75-85 foot range, and 150 are scallopers in the 75-85 foot range. Most boats are owner operated. In some cases one man may own a fleet of six or 7 boats. In these cases each boat in the fleet is not owner operated. There are a couple of fleets among the scallopers and draggers.

New Bedford has a fish auction run by the processors and dealers, and the port has over 20 fish dealers. New Bedford no longer has a co-op. A fuel division of a co-op is still in service, but the remainder of the co-op has been sold. Fish used to be sold mostly to Philadelphia and New York, but now fish is going just about anywhere.

The dominant gear types in New Bedford are scallop dredges and otter trawls, which account for over 90% of the landed value in New Bedford. Scallopers are significant to the monkfish catch, through a significant by-catch; gill-netters have concentrated on spiny dogfish and anglers.

In 1995, Seawatch International opened a processing plant in New Bedford, and started transferring a significant portion of its ocean quahog processing operations there from its Milford, Delaware facility. By the conclusion of 1998, the company anticipates processing 2.3 million bushels of ocean quahogs at the New Bedford plant, and none in Milford, Delaware (Alspach 1998).

2.3.3.3. New York

2.3.3.3.1 Freeport / Brooklyn Area

Freeport has 71 permitted vessels, and Brooklyn has 33. The average length, gross tonnage and horse power are slightly larger in the Brooklyn vessels than in the Freeport vessels.

According to a New York Cooperative Extension Agent, eight commercial boats are fishing out of Sheepshead Bay in Brooklyn. Three to four are draggers; one in the 70-75 feet range and the others are in the 50-foot range. There is one offshore lobster boat that is 75 feet. This boat sometimes switches to dragging. The rest of the commercial boats are small inshore lobster boats in the 40-foot range. The draggers fish primarily for whiting, summer flounder, winter flounder, *Loligo* squid, and scup. Most of the fish is sold to Fulton's Fish Market but they occasionally sell right off their boats.

The total value of all species landed in the Freeport/Brooklyn area in 1992 was about $4 million. The most important fisheries in terms of landed value are surfclam, *Loligo* squid, summer flounder, scup and lobster.

Bottom otter trawlers and surfclam dredges account for the majority of the landed value of species in the Freeport/Brooklyn area.

About seven or eight years ago, there were 25 draggers in Freeport. Today there are 5 active draggers in Freeport. The five active draggers are all inshore boats, working inside 50 miles. The largest boat is 60 feet, and the others range from 40 to 60 feet.

The four major species of fish targeted by otter trawlers in Freeport are whiting, winter flounder, summer flounder, and squid. According to one informant, they catch no appreciable amounts of other fish.

The otter trawl boats use a captain and a crew member and the boats pay on the share system. One local fisherman said that it is difficult to get a full-time fisherman to crew a boat anymore. The draggers are mostly dayboats, but they will take a forty-eight hour trip now and again for such species as *Loligo* squid. One fisherman said that 80% of their trips are day trips. The average day trip starts around 3:00 a.m. and ends about 4:00 p.m. One fisherman said the average 18 hour day trip is like 9 to 5 for a fisherman. Only one of the five draggers in Freeport is run by a father and a son. The other boats get whoever they can to work as a deckhand. All five draggers are owner operated.

Freeport General Information

The Freeport boats pack out at Jones Inlet. Three day-trip boats are tied up at Point Lookout and also use Jones Inlet to get to the ocean. Including these draggers brings the total number of draggers to eight in and near Freeport. The three trip boats take five day trips in boats ranging from 72 to 85 feet. The Point Lookout draggers fish for the same species as the Freeport draggers. Two of these boats are owner operated, and one boat is a corporation boats owned by the packing dock. The Point Lookout draggers have a crew of 2 or 3 and a captain.

Freeport has a substantial amount of tourist activity. Freeport is located near Jones Beach and has a number of charter boats. A Freeport fisherman estimates that the charter boats outnumber the commercial boats, and that the charter boats' landings are ten times that of the draggers.

2.3.3.4 New Jersey

2.3.3.4.1 Belford

The fishing port at Compton's Creek, in the towns of Belford and Port Monmouth, is on the Jersey shore of Raritan Bay, inside Sandy Hook. Historically the fisheries have been primarily in the bay and inshore waters, but offshore dragging has increased in the past decade. The fishing port is within a region that is primarily residential, with small businesses, and a major military installation. Tourism is insignificant to these towns.

For about a century, the fishing port was dependent on a large menhaden firm in Port Monmouth, which owned much of the property used by the fishing vessels, purchased menhaden from small-scale purse seiners and pound-netters, and hired local people to man its large "bunker boats" (purse-seiners). In the early 1980s the firm was bought out and the local facilities were shut down. The property was for sale, and the local fishing industry, including the cooperative, were in peril of losing access to the waterfront that they needed. With help from the Port Authority of New York and New Jersey, the people of the community mustered support to buy the property themselves, part of which was later sold to a waterfront developer for industrial uses (to minimize conflicts that would arise from upper-scale residential and yacht-club waterfront uses).

According to the NMFS port agent, in 1993 Belford had 32 core boats, mostly draggers, lobster pot boats, and pound-netters. If this figure is accurate, it represents a significant decline from 1984, when there were 67 vessels, 36 operated by members of the coop (and generally larger, the draggers, lobster boats, and pound net boats), and 31 operated by independent fishermen, who were engaged primarily in shellfishing or a combination of fish and shellfish harvesting (Princeton Economic Research 1985). NMFS permit files show 52 vessels permitted for squid/mackerel/butterfish, summer flounder, and/or northeast groundfish in the Belford, Keyport, and Port Monmouth area.

<u>Species Landed</u>

The total landed value for Belford in 1992 was about $9.2 million. Although the base may not be comparable, the figure suggests a dramatic increase in landed value since 1984, when landings had a value of $2.9 million (MaCay *et al.* 1993). In recent years ocean quahog vessels have moved to the port of Belford, with the result that the landed value for the port is now dominated by ocean quahogs (32% in 1992). Excluding ocean quahogs from the data, lobster is the most valuable (46% of landed value in 1992), followed by blue crab, summer flounder, menhaden, silver hake, and *Loligo* squid.

<u>Major Gear Types</u>

Ocean quahog dredges and lobster pots are the major gear types. The by-catch of inshore lobster pots includes black sea bass (0.9%) and summer flounder. (0.02%), and for offshore lobstering, black sea bass (3.6%).

There is a small sink gill-net fishery, which accounts for (0.6%) of the total landed value. It is dominated by weakfish (50%) and bluefish (39%), and includes butterfish, summer flounder, dogfish, black sea bass, and scup in small quantities.

Belford also has one of the last menhaden purse seine operations in the region. It's bycatch includes bluefish, Atlantic mackerel, weakfish, and scup, all at less than 1% of the seiner's total landed value.

Bay pound-nets are also still found in the Belford fishery. Their catches reflect the full panoply of species available in coastal waters in the warm-weather months.

The otter trawl accounts for 19% of the total landed value (much higher if ocean quahog dredges were not included). The species composition of otter trawl catches varies seasonally and over the years. In 1992 it was dominated by summer flounder (26%), silver hake (22.5%), and *Loligo* squid (14%), winter flounder (11%), and scup (9.3%).

Other Gear Types

Crab dredging is an important winter activity, and accounts for about 5% of landed value. Run-around gill nets are sometimes used for bluefish. Handlines and longlines are used for large pelagics (1.8%). There is a small amount of sea scallop dredging (0.8%), with a small angler by-catch. Eel pots and blue crab pots are also used at Belford.

Marketing

The local cooperative handles virtually all of the finfish landed in the Port of Belford; other firms handle lobster and shellfish. The cooperative has a recently expanded market, financed through the Port Authority of New York and New Jersey, that deals directly to consumers, as well as wholesale, and an ice maker and storage room and loading areas. It serves a highly diverse clientele, including small vendors in New Jersey's urban areas and ethnic minorities, including Asian-Americans who come for specialties such as black sea bass. Fish that cannot be sold locally is sent to Fulton Fish Market, South Philadelphia, or other regional fish markets.

The Belford fishing fleet is a community defined by locale, mutual interests, activity, competition, and cooperation. (McCay *et al.* 1993). The community is also defined by relatedness. Fourth and fifth generation fishermen can be found at Belford, as well as newcomers. Many of the current fishermen are closely related to each other. In a survey done in 1984, only 2 respondents (5%) indicated having no relatives in the fishery, past or present). This rate is extremely high, even for more isolated fishing communities studied by anthropologists and sociologists.

It is also somewhat surprising, for a port very close to the center of a major metropolitan area, to find that most of the people live very close to the port, contributing to a strong sense of community. The "Bayshore" communities of Belford, Port Monmouth, East and West Keansburg, etc., are still places where people with modest and uncertain incomes can afford home ownership. Homes are also important for some functions of the fishery: net drying, dipping, and handing; net and gear storage, lobster and eel pot work and storage, baiting pots, and bait storage are often done at home, which is feasible given the close proximity of many homes to the port. Marshlands are also used for aspects of the fishery such as laying out pound-nets and tarring poles and pots.

Belford is also a place where fishermen have little other skilled work experience and thus are particularly dependent on fishing. The 1984 survey found that only 25% had any other work. Traditionally in bad times the fishermen may be forced to "to up the road," as they say, to find other employment, but it is relatively unspecialized and unskilled work, or similar to fishing in being seasonal and "independent" (construction work, driving an oil truck, dock work, boat building, etc.). A survey done by the Fishermen's Wives Organization of Belford showed a very high level of concern for the fate of families if fishing opportunities declined.

2.3.3.4.2 Point Pleasant

The town of Point Pleasant is located at the mouth of the Manasquan inlet in Ocean County. The town's economy is geared towards the summer tourist and recreational economy. However, it is not only a "beach" town and has other industries. The commercial, party/charter boat, and recreational fishing industries are very important to the local economy, employing many of the local residents and supporting many related industries such as seafood markets, restaurants, marine supply houses, welders and salvage, and many of the tourist-oriented industries.

At present there are two commercial docks in Point Pleasant. One is a cooperative whose members drag or gillnet for finfish. The other dock supports primarily surfclam and ocean quahog dredgers.

The two docks represent only a fraction of the commercial fishing operations that once thrived in the community. The decline in the number of commercial docks has many causes, including relatively poor landings, competition for dock space with private marinas and party/charter boats, and a general lack of interest in commercial fishing in the younger generations. The decline is continuing today, with one dock closing within the last two years and one closing in winter of 1993. The remaining commercial fishers are struggling to maintain their niche in the greater tourist-oriented community.

For the ocean and bay fisheries of Point Pleasant, the entire landed value was about $16,000,000 in 1992. The major species landed in 1992 (by percentage of landed value) were ocean quahogs, sea scallops, surfclams, *Loligo* squid, and quahog (hard clam).

<u>Cooperative</u>

The cooperative in Point Pleasant currently holds two docks adjacent to a party/charter boat dock and across from a coast guard station. These docks can accommodate a little more than twenty vessels of a mixture of trawlers and gillnet boats. It has an ice-making machine, a cold storage facility, a retail store, and a station for loading trucks.

The retail store at the cooperative deals in both locally-caught and fish from other states. It sells fresh and frozen fish and prepares food as a restaurant. It employs eight workers in winter and fifteen in summer. All workers are hired locally. The workers are a mixture of men and women, and the manager is a woman.

The cooperative has three off loading stations, each of which can be operated simultaneously. The cooperative can offload all of its trawlers in a day if the trawlers stand and wait to be off loaded. There are six full-time dock employees. This number grows to fourteen during busy days, when people from party and charter boats are hired to work. All employees are locals. Although no exact information is available, it was observed that at least a few of the dock employees are African Americans.

The cooperative currently handles fourteen member trawlers and six gillnetters. It also off loads two non-member boats. Although dock space is scarce, it is known to handle transient vessels from Belford in the winter months and from other states as well.

While it is possible to land at the cooperative for free, the lack of dock space makes this an unlikely possibility. Docking is usually reserved for cooperative members only. To become a member of the cooperative it is necessary to prove that you are an able fisher and buy a share in the cooperative, a fee than can be several thousand dollars.

The allure of the cooperative lies in its marketing strategy and in its services to its members. Because of the limited dock space in the area, trawling has been limited. Competition from other ports was limited because Point Pleasant has access to a dredged channel out into the mudhole, allowing them access to fishing grounds even during foul weather. As a result, the cooperative was until recently one of the only consistent suppliers of silver hake to the fresh fish markets of New York. With Belford and a few other ports Point Pleasant comprised a defacto oligopoly over the whiting market. As a result, their skill at marketing whiting was well developed. This draw was probably the most important aspect of the cooperative and allowed the continued loyalty of its members.

In addition to marketing, the cooperative offers ice, packing, and fuel at discounted prices to its members. Most gear is purchased from a marine supply house located near the cooperative. Net repairs are done on the boat or at the supply house.

Bottom Trawlers

There are currently fourteen member trawlers at the cooperative. This is a decrease in the number from the late 1970's, but the number can increase again. They are all wooden-hulled vessels from 45-65 feet in length. They are geared only for bottom fish trawling, but carry several cod ends depending on what they anticipate trawling for, where they are trawling, and the gear laws governing certain nets (such as the ones governing summer flounder nets). In general the trawlers will carry three nets: the targeted species's net, a backup, and a mixed trawl net.

Including the captain, the vessels usually have a two or three-man crew. They are payed a share of the profit the catch makes. They are all hired locally, but seldom are they composed of the captain's family. At one point, however, most boats had a crew composed of the captain's family. Some of the crew (perhaps two in the entire fleet) are women, but none are minorities. I was told that "... its not that we don't let them, its just that they don't want to fish".

All of the trawlers are owner-operated. The captains are middle-aged, probably between 40 and 60 years old.

Depending on what is being targeted, the trawlers will fish in the Mudhole or Gully. Traditionally, they would fish closer inshore in the Mudhole to take advantage of the dredged channel and the brevity of the trip. Poor landings of silver hake in recent years have forced most of the trawlers to move north into the Gully where whiting seem to be more plentiful. The average trip for a trawler steaming to the Mudhole is one to three days, while a trawler heading to the Gully can have a trip of one week. The Gully trips are not desirable, because they are away from their family, add more fuel expenditures, and place the crew and their boats at considerably more danger than they would face in a trip to the Mudhole. The small wooden-hulled vessels simply do not handle long arduous trips well.

The cooperative does not force the trawlers to land at their docks. Therefore, the trawlers can land in the smaller Cape May Co. docks and in Newport, Rhode Island. These extended trips are not desirable because they are away from home and family, and their boats are subjected to added danger and expense.

Most of the trawlers at the cooperative consider themselves to be specialists in silver hake. However, different species can be targeted at different times, depending on the conditions of the ocean, the market, and the whims of the captain. In any particular trawl there is a potential for considerable bycatch,, but it can be controlled for by knowing where to place the gear and how to fish for a particular species.

2.3.3.4.3 Barnegat Light / Long Beach Island

The community of Barnegat Light is located on Long Beach Island, a barrier island along the New Jersey shore. The island up to and including Barnegat Light is intensely developed with summer and beach/boarding houses, and much of the community is heavily geared toward the summer beach economy. During the winter, Barnegat Light's economy slows significantly, and one of the major forms of employment becomes commercial fishing. It hires 150 people working on docks and is one of the biggest income-generating businesses on the island during the winter.

The commercial fishery on Long Beach Island consists of two large docks in Barnegat Light and a smaller dock "across the bay." The docks at Barnegat Light support a total of 36 full time resident commercial fishing boats as well as a few transients and about 40 recreational and charter boats. There is no competition for dock space between the commercial and recreational boats, partially because they share space at least at one dock.

The larger region, including Barnegat Bay ports, had landings worth about $32 million in 1992. Major species, by percent of the landed value (excluding surfclams and ocean quahogs) were: sea scallops, hard clams (quahogs), swordfish and tuna, and tilefish.

Dock 1

Dock 1 is an entirely commercial dock that accommodates eight scallopers, eight boats that longline for swordfish, tuna, and tilefish, seven gillnet boats, and three bottom longliners that fish for tilefish year round. The docks handle no transient vessels, partially because of a lack of space and partially because of the difficulty of navigating Barnegat inlet.

The dock has three off loading stations, but can only offload two large boats at once. Off loading is accomplished by 5-6 full-time employees (hired locally) and the captain and crew of the vessel. During peak season, however, more people are hired to help in the off loading.

The dock is privately owned by two partners, both of whom are commercial fishermen themselves. These partners do some of the marketing, selling primarily to fresh fish markets in Boston, Philadelphia, Maryland, and New York. In addition to the fresh fish markets, the dock also sells to wholesalers, retailers, and local restaurants. It also operates its own fresh fish market from April-October. However, the dock allows the boats that use its dock space to find their own markets if they so desire.

In addition to marketing, the dock supplies the services of packing (for a fee) and sells ice, fuel, and bait to the boats. There is no fee to dock and there is no membership.

Dock 2

Barnegat Light has one other private dock which accommodates 10 commercial boats, 15 charter boats, and 25 recreational vessels. It has off loading facilities for up to five vessels, with two people at the docks working at off loading, and the crew of the boat doing the lion's share of the work. The dock is an off loading facility only. All fish are marketed by the captains of the vessels, and all sales are handled by the captains, who sell to local fresh fish markets. a third dock is located "across the bay" from Barnegat Light. The third dock deals primarily with bay shellfish and inshore bay finfish.

There are currently four pelagic longliners and six gillnetters at the dock. They target the same species as mentioned above. In addition to the resident boats are several transient boats that come in from Long Island, New England, and Florida. All the vessels are owner-operated and the crew is hired locally on the resident boats.

2.3.3.4.4 Cape May

Cape May is the most southerly town in New Jersey. The town is noted for its tremendous tourist and beach economy during the summer. While there are marinas in the town, there is little conflict for space with the commercial fishermen because the commercial docks are separated from the rest of the community.

Along one stretch of road lies most of the commercial fishing docks in the town. These include a surfclam dock and three commercial finfish docks.

All told, there are 33 local draggers operating from Cape May docks, most of which are wet boats. There are some equipped with refrigerated sea water (RSW) capacity and seven boats with flash freezers. Many transient boats (57 in 1992) land in the Cape May/Wildwood area from places like Pt. Pleasant. and Port Judith, especially to take advantage of winter stocks of *Loligo* squid and to find safe harbor during storms.

For the Cape May/Wildwood area, the entire landed value for 1992 was about $37 million. Cape May landed about $30.4 million, Wildwood landed $4.5 million, and other ports in the Cape May area landed $2.3 million. Major species landed include sea scallops, ocean quahog, *Illex* squid, *Loligo* squid, and surfclams. Other ports in this area include Cold Spring Harbor, near Cape May, and Sea Isle City, to the north. There are now two tilefish boats, two fish trap (pot) boats and one dragger working out of Sea Isle City, and tilefish and black sea bass are the species targeted.

General Outline of Cape May/Wildwood Fisheries

Tilefish are not landed, except in Sea Isle City. Scup are targeted by draggers. Black sea bass are caught by pot boats and some draggers. Fluke are targeted by draggers. Dogfish are caught by gillnetters in November, December and in the spring at which time they switch from the spiny dogfish to the smooth dogfish. Draggers target dogfish in the early winter months. Some draggers may just catch them if they happen to run into them. Atlantic mackerel are targeted by draggers in the winter. *Loligo* squid is almost a year-round fishery for draggers. But they may be going for either squid on a trip. *Illex* squid is caught by draggers from May to October. Butterfish are a bycatch of squid and are rarely targeted. Gillnetters catch weakfish but there aren't many doing this anymore because of state regulations. So there is a drop in these landings. Draggers also target weakfish. Bluefish are caught by gillnetters and they are a bycatch for draggers.

Numbers of Boats

In addition to local boats, a large number of transient boats from North Carolina, Virginia and some northern states land here. Currently there are 33 local draggers in Cape May/Wildwood which includes 7 freezer boats. In 1993, 57 transient draggers landed in Cape May/Wildwood. There are two offshore lobster pot boats, ten gillnet boats (some of these boats are part-time gillnetters or they may set conch pots), and six black sea bass pot boats (some of these also set lobster pots). The sea bass pot fishery doesn't really have an off-season, but some of these individuals may work on a dragger during the winter.

The number of boats has been stable here in the last three years. One possible reason is that Cape May is diversified in the species of fish landed. Other ports are dependent on one species, or only on groundfish, so they are more affected by regulations. But fishermen here will go for whatever is close and brings money. For example one year the mackerel were really close to shore so the fishermen went for that. However, squid is becoming the most important species here. Pt. Judith boats are coming down more in the winter because the squid are here, and they just land them here.

Docks

Cape May has four main fish docks/packing and/or processing places for boats that land these species. Wildwood has two fish docks, neither of which are processors. Atlantic City has no really big fish dock anymore but has two small ones nonetheless.

Dock space isn't really a problem right now. They aren't competing with condominiums or other tourist related interests for space. If the fleet grows there may be a problem.

Dock 1 is the largest fin-fishing company in Cape May. The dock consists of seven off loading stations, a freezer facility (18,000 metric tons), a squid sorting/cleaning area, an area for cleaning and sorting flat fish and other bony fish, a central marketing area, and dock space. Currently there are six freezer boats, 14 RSW capacity boats, and several wet boat trawlers. There are also five or six trap/pot boats and a few gillnetters. Less than twenty transient boats land here from time to time. All boats fishing out of Dock 1 full-time are independently-owned and operated.

Currently there are 110-125 people working at all times in the processing plant. During busy seasons the crew can expand to 150-160 workers full-time. Work sometimes continues all day long, but work is done in shifts. Most of the key personnel are from Cape May County. The rest are contracted from Philadelphia, and are predominantly southeast Asians. In general, 25-30 people work at stations that sort, grade, and clean squid.

Located immediately adjacent to Dock 1 is Dock 2. Dock 2 is a smaller fishery than Dock 1 that specializes in squid or mackerel. The largest catch varies from year to year according to market conditions, opportunities, and stock. It has a processing room, cutting room, freezers, a large retail market, and a restaurant.

Much of the same thing could be said of Dock 2 as Dock 1. They catch a substantial amount of squid for export market. However, we noticed much more processing of flatfish at Dock 2. Some of the boats had RSW, but some of the smaller boats did not. There were also a few scallopers. It is also a smaller fishery than Dock 1. Their primary fishing grounds are in the Wilmington Canyon area.

Besides the export market and local fresh fish market, the fish are sold through the retail market and restaurant. Although this market cannot accommodate the large volume of fish entering the docks, it does sell some of the fish.

About 30 workers are contracted from Philadelphia. Most were southeast Asians, about 60% female and 40% male. In addition to these workers were a few gillneters who were hired locally.

There are two hook and line boats, 6 trap boats, and 32 trawlers at Dock 2. There are 2 boats with RSW and one freezer boat.

The dock has 2 off loading stations. There is no fee to dock at Dock 2. Not all the boats are owner-operated.

The third dock deals mostly with processing round and flatfish for a domestic market. It is known to process large amounts of dogfish for a domestic fillet market, back meat for Germany, and for English fish and chips. It is located near Dock 2. It currently services about 12 boats.

The dock handles a variety of fish depending on the season. During the winter they handle dogfish, scup, mackerel, and others.

Freezer Boats

There are currently six freezer boats at Dock 1 and one at Dock 2. These boats can be between 90 and 120 feet with steel hulls and large storage capacities. They are fixed with trawl gear and usually carry a mixed trawl net and a squid net.

The crew size of these vessels is about 6 people, although this can vary. They are all hired locally but are not composed of the captain's family. The captains and crew tend to be male and young to middle aged.

Most of these vessels fish between 90 and 140 fathoms of water and sometimes there is much activity towards the edge of the continental shelf. They can handle trips from Cape Cod to Cape Hatteras but usually fish between the Hudson and Wilmington Canyons, because this is where the squid are usually found. There are limited ports where they can dock because of the large size of their vessels. When they do land in other places, Dock 1 makes arrangements for the catch to be shipped back to them.

RSW Vessels

There are 14 RSW vessels at Dock 1 and two at dock 2. They tend to be between 60 and 90 feet in length with steel hulls. There crew size is about 5 people that are hired locally, although few of the crews are composed of family. The captains are young to middle aged.

Most of these boats target *Loligo* and *Illex* squid, but will target scup or summer flounder depending on current landings. a few of the boats target scup or summer flounder even if *Loligo* and *Illex* are currently landing much product.

Wet Boats

Normal bottom trawlers exist at all docks in Cape May. The boats tend to be between 50 and 75 feet in length and are steel-hulled. They specialize in scup and summer flounder, but specialization is sketchy in the case of these boats. The only difference between porgy boats and other boats is the skill of the captain or crew at catching porgies. Often, the decision about what was to be caught was made instantaneously when the first trawl was thrown over or a judgement based on recent performance. These boats merely caught more porgies and made more money off the porgies.

These boats carry mixed trawl nets, porgy nets, or summer flounder nets. On occasion, they will also carry whiting nets.

The boats are not capable of tremendously long trips, but can be at sea for as long as a week. Usually three or four days is all that is required.

The crew size is somewhat smaller than that of the squid boats. In general it is less than ten, and usually only 3 people. The captains seem to be older than those involved in the squid fishery.

2.3.3.4.5 Atlantic City

Atlantic City's port is primarily clam boats. However it also has four boats potting for black sea bass year round. These are small boats between 34 and 40 ft. They could sea bass pot year round, but the catch is higher from the spring to late fall. There is some gillnetting here for weakfish and bluefish in the spring and fall, but this is decreasing. One individual comes here from Barnegat Light every year to gillnet for sturgeon.

2.3.3.5 Maryland

2.3.3.5.1 Ocean City

Description of the Port

The principal ocean fishing port of Maryland is Ocean City. Ocean City is a commercial fishing community with families that have been involved in fishing for at least sixty years. Ocean City is made up of approximately ten miles of barrier island and is next to an inlet that was created during a hurricane in the 1930s. Ocean City is currently the primary port for ocean fishing vessels in Maryland. Its boats are primarily smaller boats; they are either inshore boats or small trawler, day boats. Its harbor area is directly west of the inlet at the southern end of the city and is 1.25 miles from the ocean.

In the last fifteen years, Ocean City has grown into its current status as a summer resort area. It has a permanent population of about 10,000 to 14,000 and a summer population of about 250,000 to 300,000. Many hotels, condominiums and summer homes as well as other service businesses for the summer tourists exist in Ocean City. One informant said that Worcester County is the wealthiest county in Maryland precisely because of the revenue generated by tourism. Major sources of employment such as work in tourist businesses and construction are thus related to the mainstay of the economy--tourism. Most of Ocean City's growth has occurred gradually over the last fifteen years. However, new development is not taking place at the same levels it did in the past. Thus most of the construction jobs involve the maintenance of current structures. In fact, fishermen are also finding it hard to go into other industries, such as crabbing or construction, because these are depressed as well.

Dock Space

Commercial fishermen can lease dock space that the county provides on a yearly basis. It is expensive and fishermen must bid for a lease every year. One informant owns a fish house and has enough space for three boats in front of his business where his boats usually tie up. Independent boats have to tie up at the county dock space. There is a need for more commercial dock space. One informant mentioned that plans for a new marina are being made. However these will probably be dedicated to recreational fishermen.

While there is no direct competition between commercial and recreational boats at particular docks, there are definitely more marinas for recreational boats. This situation reflects Ocean City's reputation as a recreational and game-fishing port. There are quite a few marinas; one at the west end of the harbor and several in Ocean City.

Ocean City residents are begrudgingly tolerant of the commercial fishing industry. The commercial docks are located between a business and residential section. Residents are making sure the commercial businesses and boats stick strictly to the letter of the [zoning] law. Also, landside access to the harbor area is limited in that there is only one street on which a tractor trailer can drive. In the past, gear was stored on property that was zoned residential, but this practice has been eliminated. Some very expensive homes have been built close to the harbor area, and these owners do not like the sight of the gear. So the commercial fishing industry is not venerated by all the people in Ocean City.

Major Species and Gear Types

The total landed value of fish and shellfish in Ocean City and environs in 1992 was about $8 million. The surfclam and ocean quahog fishery represented 62% of that total. Summer flounder, black sea bass, spiny dogfish, weakfish, and butterfish are among the species of concern that are relatively important to the fisheries. As elsewhere in the region, the actual number of species landed and sold is extremely high.

Trends In the Numbers of Boats

The number of vessels in Ocean City has declined in the last two years primarily because of changes in the surfclam/ocean quahog fleet. The number of boats in the surfclam/ocean quahog fishery overall decreased from 150 to 70 vessels. According to one informant six vessels remain in the surfclam/ocean quahog fishery in Ocean City compared to twenty surfclam vessels over 75 feet that were present in 198. One vessel can have up to three quotas so many fishermen or companies that had more than one boat have sold some of their boats and catch three quotas with one boat. For example, one company got rid of three vessels in 1993 and is now using just two boats to catch its quota. Another family had three boats and now have only one. So the people who owned more than one boat had an advantage because they retained more quotas on fewer boats reducing their overall costs. The decline in the number of vessels in this particular fishery is a direct result of management plans.

Trawling out of Ocean City is also very dependent on fluke and weakfish regulations. But other than the surfclam and ocean quahog boats, the number of boats has been steady in the last six or seven years in Ocean City. However, no new boats have been seen in Ocean City recently. One reason given for the stability or lack of decline in the number of vessels is that most of the fishermen in Ocean City already owned their boats. Those fishermen who still hadn't completely paid for their boats are suffering financially. Some fishermen are having difficulty but they are still working. One informant predicts that the numbers may decline if "they [fishery management] keep squeezing them."

Trends in Species Landed

Ocean City used to be a big surfclam and ocean quahog port. Six vessels remain in this fishery, and the overall catch was still substantial in 1992, representing 62% of the port's landed value. Some of the boats in the surfclam/ocean quahog fishery have moved north to Belford, New Jersey, and to Long Island.

Ancillary Businesses

Businesses that serviced the surfclam and ocean quahog fishery such as trucking, fuel and ice have declined tremendously. Ice is a problem in the summer because most of it goes to the recreational boats. Some commercial boats could not get ice during the summer of 1993 and had to wait a couple of days before they could go out. One of the fish houses has since gotten its own ice machine.

Most of the welding that was done was for the ocean quahog boats. Right now there is one individual doing the welding. More and more of the captains are becoming proficient at welding as a result.

When the number of surfclam vessels declined, many boats and maintenance businesses were lost. Very few ancillary businesses in Ocean City specialize in marine repairs. The dry docks in Virginia and New Jersey also lost business because of fewer boats. The decline affected a lot of people.

Marketing

There are unloading areas in Ocean City as well as local buyers. Fluke and sea bass are taken to New York or Norfolk to bigger fish houses. The dogfish go north to Maine, New Hampshire and New Bedford. Dogfish landed in Chincoteague go south. During the summer, one particular buyer can fillet and sell all the fluke landed from three boats just to the local population. At other times of the year a truck will run to dealers in Baltimore. Big-eye tuna and the best yellowfins go to Japan and bring a lot of money per pound. Sometimes $8 to $12/lb. Swordfish brings about $5.50/lb.

One informant owns a fish house and buys fish from trawlers and other boats. This company washes and grades different species of fish. They also process flounder. They ship most of their product to New York, Baltimore and Philadelphia, and some to the south to the Carolinas.

One informant said that a lot of wholesalers he has traditionally done business with have gone out of business. The decline in fish stocks and the fishery closures have made business difficult for the wholesalers. These closures are also not good for the market because people forget about the fish. For example, one informant predicts that by the time fishermen are able to catch rockfish again, consumers may not want it anymore.

Social Nature of the Fishery

Ocean City has a long tradition of fishing. Fishermen had pound nets in the ocean before the inlet was there (before the 1930s). Family is an important part of the commercial fishing industry in Ocean City. There is at least one prominent fishing family that hires other family members. However not all the families in Ocean City are that big. Family is particularly important in one informant's business. This person buys fish primarily from boats owned by his brothers or brothers-in-law. In fact, most of the trawl boat owners in Ocean City are part of this family. There are some independents, i.e. individual boat owners who are not owners of a packing or processing plant or related to these owners.

Most of the vessels in Ocean City are owner-operated, but a few hire captains. The transient longliners are generally not owner-operated. They are owned by a seafood company.

Share System

Most owners pay their crew using a share system. There is one longliner who pays one crew member per trip. Usually, 50% goes to the boat and 50% to the crew and the crew pays for the fuel, groceries, and ice. The captain gets a percentage off the top before the division.

The crews have gotten smaller, and the boats have had to take more of the share to cover higher expenses such as insurance, maintenance, paint, engine repair, nets, electronics and other equipment. a crew size of at least two is necessary, but the number in the crew is smaller than it used to be. Harder working people are more likely to be on the boats today because they need the work and are more conscientious about their job.

Education and Skills of People Involved in the Fishery

Most of the crew have some fishing experience from fishing in the bay. A few of the captains have Masters or Bachelors degrees and some are high school graduates.

Ethnicity

A few African-Americans are in the crews and at least one boat had an African-American captain. Some of the boats from North Carolina also have African-American captains and crews.

One informant employs four or five African Americans in his crews and has one African American captain. He also has five African Americans and two or three European Americans in packing. He also has two dock foremen, one white, one black. The crew live mostly within the 20 mile area, however there is one captain from Seaford, Delaware.

Women in Fishing

No women are currently fishing. There have been a couple in the past. There was a woman captain on a transient gill-net boat from New England. According to one informant, few women are part of crews in Ocean City because the boats are small and have few facilities (beds, toilets) and the work is very hard.

Age

In general the crew are younger men because of the labor involved. Captains range in age from 23 on up. Commercial fishing is not an industry in which young, seasonal workers or older retirees are getting involved. Perhaps a few older men may get into gill-netting.

Recreational Fishing

Ocean City is a well-known recreational fishing port with many offshore charter boats. In fact, one informant stated that Ocean City is the White Marlin capital of the world. Many pelagic boats also target tuna, yellowfins, bluefins and big eyes. The county ramp can accommodate larger boats. Recreational fishermen fish for Atlantic mackerel in particular. There are four or five headboats in Ocean City. Headboats will hook and line for sea bass.

Issues

The following were issues discussed by the informants concerning the commercial fishing industry. As expected, the issues brought up by the informants are primarily concerned with fishery management decisions.

The trawl fishermen from North Carolina are required to use Turtle Excluder Devices in North Carolina and other areas in which sea turtles are common. As a result, these boats have fished further north, in colder waters, where the TEDs are not required.

"The regulations have gotten so bad many of the fishermen that I've known since I started this job won't talk to me anymore. These are people I live with and have had dinner with, whose families I know." The paperwork involved with the regulations is also overwhelming. For example, the dealers' data on the amount of fish bought has to agree with the weighout data. "I'm already four months behind. And if they require the logbook data, we're going to have to check against that too." Massachusetts had a state reporting system, but there was a big discrepancy between the state and federal numbers. One problem is that their reporting periods are different, so a dealer or fisherman would have to figure his catch from Sunday through Saturday on one, and perhaps Monday through Sunday on another, so the numbers would not be the same for the same week. "The Councils have demanded quite a bit." Also letters have been sent out extending permits, probably because the government agency does not have the time to renew them. "These are some of the reasons that I hope to retire next year."

According to one informant, the commercial fishermen are bearing the brunt of all the things that are happening in this country that affect fish, such as pollution. The commercial fishermen are just easier to pick on that large companies or farmers. For example, people in upstate New York are affecting the fisheries but they are not having to pay.

Another informant said that many fishermen dislike the quotas and closing of fisheries more than they do mesh size requirements.

3.0 ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES

3.1 MANAGEMENT ALTERNATIVES

3.1.1 Preferred Measures to Attain Management Objectives

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

Section 600.310 (b) states that the determination of OY is a decisional mechanism for resolving the Magnuson-Stevens Act's multiple purposes and policies, implementing an FMP's objectives, and balancing the various interests that comprise the national welfare. OY is to be based on MSY, or on MSY as it may be reduced for social, economic, or ecological reasons. The most important limitation on the specification of OY is that the choice of OY and the conservation and management measures proposed to achieve it must prevent overfishing. These specifications will not change based on new overfishing definitions. OY may not exceed MSY.

3.1.1.2 Definitions of overfishing

3.1.1.2.1 Surfclams

The current overfishing definitions for surfclams and ocean quahogs, as defined in Amendment 9 (MAFMC 1996), need revision because they are based on a fishing mortality rate that minimizes the potential for recruitment overfishing ($F_{20\%MSP}=0.18$ for surfclams and $F_{25\%MSP}=0.042$ for ocean quahogs), rather than a specific MSY strategy. In addition, the Amendment 9 overfishing definition has no biomass estimates associated with either the target or threshold overfishing level. Section 2.1.4 on maximum sustainable yield summarizes the history of MSY calculations for surfclams and ocean quahogs and describes how the Council has prevented overfishing in these two species for the past twenty years of federal management.

Reference Point	Basis	Estimated Value
Surfclam		
Biomass Target	1997 NNJ biomass as proxy for B_{MSY}	900 million pounds
Biomass Threshold	½ Proxy for B_{MSY}	450 million pounds
Fishing Mortality Target	F_{PO}	0.05
Fishing Mortality Threshold	$F_{20\% MSP}$	0.18
Current F for NNJ		0.04
Ocean Quahogs		
Biomass Target	½ Virgin Biomass	2 billion pounds
Biomass Threshold	1/4 Virgin Biomass	1 billion pounds
Fishing Mortality Target	$F_{0.1}$	0.02
Fishing Mortality Threshold	$F_{25\% MSP}$	0.042
Current F, exploited area		0.021

The Council has had at least a 10 year supply horizon for surfclams and at least a 30 year supply horizon for ocean quahogs as its policy for annual quota setting for nearly a decade. The overfishing level defined in Amendment 9 was a "threshold" beyond which the long-term productive capability of the stock is jeopardized. It was concluded in Amendment 9 that the Council's quota setting process is more conservative than the rate-based overfishing levels, given the current resource conditions.

A number of biological reference points and harvest policies have been proposed for management of EEZ populations of surfclams and ocean quahogs. The Council's harvest policy has been erroneously called a mining policy, in which the resource is fished to extinction over some finite planning horizon (Rago 1998). In reality the policy is a risk-averse adaptive strategy that computes a harvest rate based on current estimates of population biomass and an assumed level of recruitment to the population. The most conservative assumption, that recruitment is zero, implies the lowest harvest rate. Harvest levels are recomputed each year using the predicted population size as the measure of abundance. Periodic surveys of the resource are used to update abundance levels, thereby allowing revision of harvest levels in response to actual resource conditions. At SARC 26 (NEFSC 1998a), surfclam harvest levels were recommended to be set so as to maintain current population biomass. This policy recommendation seeks to preserve current resource levels by allowing harvest of projected biological production (Rago 1998).

The SARC 26 (NEFSC 1998a) did not have as a "term of reference" the development of an overfishing definition for surfclams because the final SFA guidelines were not available in December 1997. SARC 27 (NEFSC 1998b) did have as a "term of reference" the development of overfishing definitions for both surfclams and ocean quahogs, however members of SARC 27 felt that they could not constructively comment on surfclam overfishing definitions because they had not reviewed surfclam information. The SARC 27 concluded that: "No new information is available since SAW-26, at which time the SARC recommended that the catch associated with net production would maintain the population in the area(s) being fished."

With the need for a new overfishing definition to meet the SFA requirements for this Amendment, Council staff worked with several NEFSC scientists to develop the following approach for surfclams. The recent SARC (NEFSC 1998a) declared that surfclams are"probably under-exploited overall".

Estimation of MSY requires an estimate of B_{MSY}, the stock biomass that will produce MSY. Due to data limitations for surfclams involving temporal changes in survey dredge catchability as well as lack of information on the relation between productivity and stock biomass, it is not feasible to get an analytic estimate of B_{MSY} from application of quantitative fisheries models. Furthermore, the dominant factor that controlled the size and structure of this stock in the last two decades was the hypoxic event of 1976, which caused mass mortality of surfclams and surfclam predators. Year classes and resulting stock biomasses that occurred after that event were likely atypical of what could be sustained by the resource in the long-term. The current surfclam fishery has been based on harvesting the cohorts that recruited throughout the 1980's and 1990's. a hypoxic event of similar magnitude could occur again in the future, but it can neither be predicted nor controlled. Thus, it is reasonable to base management decisions for this species on the current state of the stock and recent trends in fishery performance.

Several lines of evidence suggest that the 1997 biomass estimate for Northern New Jersey (NNJ) is a reasonable proxy for B_{MSY} , and that the annual production from that region is a reasonable proxy for MSY. These include:

- Annual production of biomass by surfclams in the NNJ region, where 80% of the landings are typically taken, is roughly equivalent to the annual EEZ quota.

- About 80% of commercial EEZ landings are typically taken from the NNJ region. While being exploited, mean shell length in this region has remained stable since 1985.

- Landings per unit effort (LPUE) by large vessels in the NNJ region have declined slightly since 1991, but have remained stable for the last four years (1994-97) at 1,650 - 1,750 pounds of meat/hr fished.

- Annual recruitment has occurred repeatedly in the NNJ region where the fishery has been prosecuted. This is reflected by the large number of year classes in the stock in 1997.

These lines of evidence suggest that present harvests from this region are sustainable, at least for the next few years. It is not known, however, whether this is the maximum harvest that could be realized.

Current biological reference points for Atlantic surfclam are $F_{max} = 0.21$, $F_{20\%MSP} = 0.18$, $F_{0.1} = 0.07$ and $F_{P0} = 0.05$. F_{P0} is the fishing mortality rate in the NNJ region that would result from an annual catch equal to the annual production of biomass by that region. F_{P0} is recommended as an overfishing target, and the other biological reference points represent options for overfishing thresholds. All of the reference point estimates are sensitive to the value for natural mortality, M, which was assumed = 0.05. There is considerable uncertainty as to the true value of this parameter. If true $M > 0.05$, then both annual biomass production and F_{P0} are overestimated. Table 1 lists the most recent estimates from SARC-26 (NEFSC 1998a) of surfclam biomass, landings, F and production, by region and across regions. The most recent estimate of F for the NNJ region was 0.04, which is just below F_{P0} .

Exploitation rates in other areas are typically lower than the production rates and population status differs markedly across regions. Production rates tend to be lower in the Delmarva region where dense populations of slower growing individuals have accumulated in the absence of high fishing mortality. In contrast, unfished populations on Georges Bank appear to be accruing biomass each year. Owing to a large difference in primary productivity between these regions, it is not possible to derive simply an empirical biomass dynamics model. Intensive monitoring of regional populations, particularly in response to changing harvest patterns, may be sufficient to elucidate the underlying MSY. Until then, prudent quotas set at levels near current landings should be sustainable and exhibit minor interannual variation.

In regions that are currently unfished, F_{PO} for each region could serve as a reasonable proxy for F_{MSY}. It should be noted, however, that biomass and production levels should not be pooled across regions or years to define a global B_{MSY} and global MSY, respectively. Surfclams are sessile and local overfishing would occur if landings equal to a global MSY were taken from a single region such as NNJ. The regions defined in Table 1 appear to be on the appropriate physical scale for population management. Thus, increases in yield might be achieved from certain regions as long as the yield did not exceed that region's annual production.

In summary, the data are insufficient to accurately estimate B_{MSY} , MSY or F_{MSY}. However, stable yields, absence of change in mean length, successful recruitment, and the rough equivalence of production in NNJ with harvests imply that the current policy is at equilibrium with the resource and may be near the optimum. Finally, it is noted that there is consistency between the current recommendation and earlier modeling results by Murawski and Idoine (1989). Their simulation model of surfclams under exploitation, which incorporated numerous population parameters including variability in recruitment among years, indicated that a constant-catch policy of 45 to 55 million pounds of meats/yr would achieve a balance between yield maximization, low interannual variation in yield, and risk-aversion.

As further justification of the sustainable nature of the resource with these harvest levels, the estimate of MSY in the original FMP was 2.9 million bu. (approximately 50 million pounds of shucked meats) over the range of the resource, which was based on commercial landings from 1960-1976 (MAFMC 1977). In Amendment 8 (MAFMC 1988) the MSY section concludes, after extensive modeling by the NEFSC, that: "In terms of the overall MSY, it appears that the previous estimate of 50 million lbs of shucked clam meats everywhere, is probably the best current estimate for the mid-Atlantic EEZ surfclam population."

In conclusion, the new overfishing definition "target" for surfclams will be the 1997 biomass estimate for Northern New Jersey (NNJ) as a reasonable proxy for B_{MSY} and the associated F_{PO} (replacement level) level of fishing mortality that would result from an annual catch equal to the annual production of biomass by that NNJ region. The overfishing definition "threshold" would be ½ the B_{MSY} proxy (as recommended by the Applegate *et al.* 1998 Overfishing Definition Review Panel report) with an $F_{20\%MSP}$ level of fishing mortality that should never be exceeded. The $F_{20\%}$ MSP level is the threshold level recommended by the NEFSC for Amendment 9 (MAFMC 1996) and reviewed and approved by the MAFMC Scientific and Statistical Committee. Annual quotas will be specified which correspond roughly to the target fishing mortality rate. Quotas will be set annually by the Regional Administrator according to the FMP.

The annual Optimum Yield (OY), Domestic Annual Harvest (DAH), Domestic Annual Processing (DAP), and annual quota for surfclams equal between 1,850,000 and 3,400,000 bushels (approximately 31.5 - 57.8 million lbs of meats). However, OY will never exceed MSY.

Prior to the beginning of each year, the Council, following an opportunity for public comment, will recommend to the Regional Administrator quotas and estimates of DAH within the ranges specified. In selecting the quota the Council shall consider current stock assessments, catch reports, and other relevant information concerning: exploitable and spawning biomass relative to the OY; fishing mortality rates relative to the OY; magnitude of incoming recruitment; projected effort and corresponding catches; geographical distribution of the catch relative to the geographical distribution of the resource, and status of areas previously closed to surfclam fishing that are to be opened during the year and areas likely to be closed to fishing during the year. The quota shall be set at that amount which is most consistent with the objectives of this FMP. The Regional Administrator may set quotas at quantities different from the Council's recommendations only if he can demonstrate that the Council's recommendations violate the National Standards of the MFCMA and the objectives of this FMP. It is the Council's intent that this quota setting process will not involve the preparation of an FMP amendment and a Supplemental Environmental Impact Statement to establish the annual quota.

Since OY, DAH, and DAP are specified as equal to each other, joint venture processing (JVP) and total allowable level of foreign fishing (TALFF) equal zero. Hence, fishing for surfclams in the EEZ by any vessel other than a vessel of the US is prohibited.

3.1.1.2.2 Ocean quahogs

For MSY of ocean quahogs, it is generally assumed that MSY for harvested populations occurs at one-half the virgin biomass. The 1997 surveyed biomass estimate (roughly 3 billion pounds of meats) is at about 80% of the virgin biomass (roughly 4 billion pounds of meats) and exploitation rates are below $F_{0.1}$, $F_{25\%}$, and F_{max}. The combination of current biomass and F is highly unlikely to represent overfishing, as defined by the current SFA guidelines (NEFSC 1998b). There is however, significant time to determine the exact nature of the sustainability of the resource, since total removals (which have averaged about 40 million pounds/year) over the past two decades have only reduced the virgin biomass by about 20%.

The current biomass is less than the likely carrying capacity of the resource, but well above K/2. Moreover, the current fishing mortality rates are well below existing fishing mortality rate thresholds. Current status of the ocean quahog resource is schematically depicted in Figure 8. The 1997 surveyed biomass estimate (roughly 3 billion pounds) is at about 80% of the virgin biomass (roughly 4 billion pounds). This figure suggests that fishing mortality rates are below two alternative action levels and that overall population biomass exceeds levels which would require rebuilding. Nonetheless, 22 years of harvesting appear to have reduced the population in some areas. It is not yet possible to characterize the dynamic response of the population to these decreases in density. In many instances, the recruits that might have been produced as a result of prior reductions are only now becoming vulnerable to the survey dredge. Thus, some caution is necessary in the interpretation of Figure 8.

In conclusion, the overfishing definition "target" for ocean quahogs is one-half the virgin biomass and the $F_{0.1}$ level of fishing mortality for the exploited region. The overfishing definition "threshold" would be one-half B_{MSY} or one-quarter of the virgin biomass (as recommended by the Applegate *et al.* 1998 Overfishing Definition Review Panel report) with an $F_{25\%MSP}$ level of fishing mortality that should never be exceeded. The $F_{25\%}$ MSP level is the threshold level recommended by the NEFSC for Amendment 9 (MAFMC 1996) and reviewed and approved by the MAFMC Scientific and Statistical Committee.

The annual OY, DAH, DAP, and quota for ocean quahogs range between 4.0 million bushels and 6.0 million bushels (40 - 60 million pounds of meats). However, the OY will never exceed the

MSY. The annual quota and estimates of Domestic Annual Harvest and Domestic Annual Processing for ocean quahogs will be developed following the procedures described above for surfclams.

Since OY, DAH, and DAP are specified as equal to each other, JVP and TALFF equal zero. Hence, fishing for ocean quahogs in the EEZ by any vessel other than a vessel of the US is prohibited.

3.1.1.3 Essential fish habitat definition

The SFA significantly altered the requirement of FMPs to address habitat issues. The SFA contains provisions for the identification and protection of habitat essential to the production of federally managed species. The act requires FMPs to include identification and description of essential fish habitat (EFH), description of non-fishing and fishing threats, and suggest conservation and enhancement measures. These new habitat requirements are fully addressed in this Amendment in section 2.2. The definitions for surfclam and ocean quahog EFH are:

Surfclams: Throughout the substrate to a depth of three feet within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of the area where surfclams were caught in the NEFSC surfclam and ocean quahog dredge surveys (Figure 16). Surfclams generally occur from the beach zone to depth of about 200 feet, but beyond about 125 feet abundance is low.

Ocean quahogs: Throughout the substrate to a depth of three feet within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of the area where ocean quahogs were caught in the NEFSC surfclam and ocean quahog dredge surveys (Figure 17). Distribution in the western Atlantic ranges in depths from 25 feet to about 800 feet. Ocean quahogs are rarely found where bottom water temperatures exceed 65 °F, and occur progressively further offshore between Cape Cod and Cape Hatteras.

3.1.1.4 Framework adjustment process

In addition to the annual review and modifications to management measures, the Council could add or modify management measures through a framework adjustment procedure. This adjustment procedure allows the Council to add or modify management measures through a streamlined public review process. As such, management measures that have been identified in the plan could be implemented or adjusted at any time during the year (with the exception of the annual quotas).

The following management measures could be implemented or modified through framework adjustment procedures:

1. Overfishing definition (both the threshold and target levels).
2. Description and identification of EFH (and fishing gear management measures that impact EFH).
3. Habitat areas of particular concern.
4. Set aside quota for scientific research.
5. VTS, but not solely to replace the current call-in system.
6. OY range specified in the FMP.

The adjustment procedure would involve the following steps. If the Council determines that an addition or adjustment to management measures is necessary to meet the goals and objectives of the Atlantic Surfclam and Ocean Quahog FMP, it will recommend, develop and analyze appropriate management actions over the span of at least two Council meetings. The Council will provide the public with advance notice of the availability of the recommendation, the appropriate justifications and economic and biological analyses, and opportunity to comment on the proposed adjustments prior to and at the second Council meeting. After developing management actions and receiving public testimony, the Council will then submit the recommendation to the Regional Administrator. The Council's recommendation to the Regional Administrator must include supporting rationale, an analysis of impacts, and a recommendation to the Regional Administrator on whether to publish the management measures as a final rule.

If the Council recommends that the management measures should be published as a final rule, the Council must consider at least the following factors and provide support and analysis for each factor considered:

1) Whether the availability of data on which the recommended management measures are based allows for adequate time to publish a proposed rule.

2) Whether regulations have to be in place for an entire harvest/fishing season.

3) Whether there has been adequate notice and opportunity for participation by the public and members of the affected industry in the development of the Council's recommended management measures.

4) Whether there is an immediate need to protect the resource.

5) Whether there will be a continuing evaluation of management measures adopted following their promulgation as a final rule.

If, after reviewing the Council's recommendation and supporting information:

1) The Regional Administrator concurs with the Council's recommended management measures and determines that the recommended management measures may be published as a final rule then the action will be published in the Federal Register as a final rule; or

2) The Regional Administrator concurs with the Council's recommendation and determines that the recommended measures should be published first as a proposed rule, the action will be published as a proposed rule in the Federal Register. After additional public comment, if the Regional Administrator concurs with the Council recommendation, the action will be published as a final rule in the Federal Register; or

3) The Regional Administrator does not concur, the Council will be notified, in writing, of the reason for non-concurrence.

3.1.1.5 Operator Permits

All of the other NMFS Northeast Region FMPs (with the exception of summer flounder) have commercial (at a minimum) operator permits required. The Surfclam and Ocean Quahog FMP has not had a recent major Amendment where operator permits could have been included. An operator of a vessel with a permit issued pursuant to this FMP must have an Operator's Permit issued by NMFS. Any vessel fishing commercially for surfclams or ocean quahogs in the EEZ must have on board at least one operator who holds a permit. That operator may be held accountable for violations of the fishing regulations and may be subject to a permit sanction. As a condition of this permit, if the operator permit is suspended or revoked pursuant to 15 CFR part 904, the operator *cannot be aboard* (emphasis added) any fishing vessel issued a Federal fisheries permit or any vessel subject to Federal fishing regulations while the vessel is at sea or engaged in off loading.

The permit program has the following requirements:

1) Any operator of a vessel fishing for surfclams or ocean quahogs must have an operator's permit issued by the NMFS Regional Administrator.

2) An operator is defined as the master or other individual on board a vessel who is in charge of that vessel (50 CFR 620.2).

3) The operator is required to submit an application, supplied by the Regional Administrator, for an Operator's Permit at least 30 days before the date upon which the applicant desires to have the permit made effective. The permit will be issued for a period specified by the Regional Administrator. That period is currently three years.

4) The applicant would provide at least his/her name, mailing address, telephone number, date of birth and physical characteristics (height, weight, hair and eye color, etc.) on the application, and would be requested to provide his/her social security number. In addition to this information, the applicant must provide two passport-size color photos which must be no more than one year old. The applicant's signature is required and the social security number of the applicant is optional.

5) The permit is not transferable.

6) Permit holders would be required to carry their permit aboard the fishing vessel during fishing and off-loading operations and must have it available for inspection upon request by an authorized officer.

7) The Regional Administrator may, after publication in the *Federal Register*, charge a permit fee.

3.1.2 Alternative to the Preferred Management Measure

3.1.2.1 Take No Action

Under this alternative, the definitions of overfishing for both species managed under this FMP would remain unchanged from Amendment 9 and would not include a biomass estimate. In addition, the framework process described in the above section would not be implemented to address future management problems. The mandates of the 1996 Sustainable Fisheries Act (essential fish habitat, safety at sea, communities, and bycatch) would not be addressed. The surfclam and ocean quahog fishery would remain as one of only two MAFMC FMPs that does not require Operator Permits.

3.1.3 The Amendment Relative to the National Standards

Section 301(a) of the MSFCMA states: "Any fishery management plan prepared, and any regulation promulgated to implement such plan pursuant to this title shall be consistent with the following National Standards for fishery conservation and management." The SFA added three new National Standards, including requirements that FMPs take into consideration the effects on fishing communities (National Standard 8), reduce bycatch (National Standard 9), and promote safety of life at sea (National Standard 10). In addition, the SFA requires the Councils to identify and describe essential habitat for species managed under the SFA. The following is a discussion of the National Standards and how this Amendment meets them:

3.1.3.1 Conservation and management measures shall prevent overfishing while achieving, on a continuous basis, the optimum yield from each fishery for the United States fishing industry.

The Sustainable Fisheries Act (SFA), which reauthorized and amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) made a number of to National Standard 1. To comply with National Standard 1, the SFA requires that each Council FMP define overfishing as a rate or level of fishing mortality that jeopardizes a fisheries capacity to produce maximum sustainable yield (MSY) on a continuing basis.

The SFA also requires that each FMP specify objective and measurable status determination criteria for identifying when stocks or stock complexes covered by the FMP are overfished. To fulfill the requirements of the SFA, status determination criteria for surfclams and ocean quahogs are comprised of two components: 1) a maximum fishing mortality threshold and 2) a minimum stock size threshold. Both a threshold and a target are specified for both surfclams and ocean quahogs. Each threshold and target have associated biomass and fishing mortality estimates.

The current overfishing definitions for surfclams and ocean quahogs, as defined in Amendment 9 (MAFMC 1996) need revision because they are based on a fishing mortality rate that minimizes the potential for recruitment overfishing ($F_{20\%MSP} = 0.18$ for surfclams and $F_{25\%MSP} = 0.042$ for ocean quahogs), rather than an MSY strategy. Section 2.1.4 on maximum sustainable yield summarizes the history of MSY calculations for surfclams and ocean quahogs and describes how the Council has prevented overfishing in these two species for the past twenty years of federal management.

The Council has had at least a 10 year supply horizon for surfclams and at least a 30 year supply horizon for ocean quahogs as its policy for annual quota setting for nearly a decade. The overfishing level defined in Amendment 9 was a "threshold" beyond which the long-term productive capability of the stock is jeopardized. It was concluded in Amendment 9 that the Council's quota setting process is more conservative than the rate-based overfishing levels, given the current resource conditions.

A number of biological reference points and harvest policies have been proposed for management of EEZ populations of surfclams and ocean quahogs. The Council's harvest policy has been erroneously called a mining policy in which the resource is fished to extinction over some finite planning horizon (Rago 1998). In reality the policy is a risk-averse adaptive strategy that computes a harvest rate based on current estimates of population biomass and an assumed level of recruitment to the population. The most conservative assumption, that recruitment is zero, implies the lowest harvest rate. Harvest levels are recomputed each year using the predicted population size as the measure of abundance. Periodic surveys of the resource are used to update abundance levels, thereby allowing revision of harvest levels in response to actual resource conditions. At SARC 26 (NEFSC 1998a), surfclam harvest levels were recommended to be set so as to maintain current population biomass. This policy recommendation seeks to preserve current resource levels by allowing harvest of projected biological production (Rago 1998).

The SARC 26 (NEFSC 1998a) did not have as a "term of reference" the development of an overfishing definition for surfclams because the final SFA guidelines were not available. SARC 27 (NEFSC 1998b) did have as a "term of reference" the development of overfishing definitions for both surfclams and ocean quahogs, however members of SARC 27 felt that they could not constructively comment on surfclam overfishing definitions because they had not reviewed surfclam information. The SARC 27 concluded that: "No new information is available since SAW-26, at which time the SARC recommended that the catch associated with net production would maintain the population in the area(s) being fished."

With the need for a new overfishing definition to meet the SFA requirements for this Amendment, Council staff worked with several NEFSC scientists to develop the following approach for surfclams. It is important to remember that the recent SARCs declared that surfclams are"probably under-exploited overall" and ocean quahogs "would be considered under-exploited at the scale of the management unit".

Estimation of MSY requires an estimate of B_{MSY}, the stock biomass that will produce MSY. Due to data limitations for surfclams involving temporal changes in survey dredge catchability as well as lack of information on the relation between productivity and stock biomass, it is not feasible to get an analytic estimate of B_{MSY} from application of quantitative fisheries models. Furthermore, the dominant factor that controlled the size and structure of this stock in the last two decades was the hypoxic event of 1976, which caused mass mortality of surfclams and surfclam predators. Year classes and resulting stock biomasses that occurred after that event were likely atypical of what could be sustained by the resource in the long-term. The current surfclam fishery has been based on harvesting the cohorts that recruited throughout the 1980's and 1990's. A hypoxic event of similar magnitude could occur again in the future, but it can neither be predicted nor controlled. Thus, it is reasonable to base management decisions for this species on the current state of the stock and recent trends in fishery performance.

Several lines of evidence suggest that the 1997 biomass estimate for northern New Jersey (NNJ) is a reasonable proxy for B_{MSY} , and that the annual production from that region is a reasonable proxy for MSY. These include:

- Annual production of biomass by surfclams in the NNJ region, where 80% of the landings are typically taken, is roughly equivalent to the annual EEZ quota.

- About 80% of commercial EEZ landings are typically taken from the NNJ region. While being exploited, mean shell length in this region has remained stable since 1985.

- Landings per unit effort (LPUE) by large vessels in the NNJ region have declined slightly since 1991, but have remained stable for the last four years (1994-97) at 1,650 - 1,750 pounds of meat/hr fished.

- Annual recruitment has occurred repeatedly in the NNJ region where the fishery has been prosecuted. This is reflected by the large number of year classes in the stock in 1997.

These lines of evidence suggest that present harvests from this region are sustainable, at least for the next few years. It is not known, however, whether this is the maximum harvest that could be realized.

The critical aspect of the overfishing definition is that it is sustainable for several more years which will allow NEFSC to conduct more clam surveys (1999 and 2001) and thus will provide at least two more assessments that are as thorough as those produced from the 1997 survey. New survey technology and assessment approaches (NEFSC 1998a and 1998b) provided state-of-the-art analyzes, however these changes precluded direct comparisons with previous surveys. From the latest SARC (NEFSC 1998a) surfclams are "probably under-exploited overall", and thus there is practically no threat of overfishing in the immediate future.

Finally the "proxy" nature of using Northern New Jersey needs to be emphasized. The definition uses the best science from the most recent surfclam assessment, but as new assessment information becomes available (after the 1999 and 2001 surveys), any better information will be used, and in fact, it is seriously desired that true B_{msy} and F_{msy} estimates can replace the proxy, and thus should not require an Amendment. However, if an Amendment is necessary the entire overfishing definition is frameworked and thus could quickly be changed without major impact to industry or the resource.

Current biological reference points for Atlantic surfclam are F_{max} = 0.21, $F_{20\%MSP}$ = 0.18, $F_{0.1}$ = 0.07 and F_{PO} = 0.05. F_{PO} is the fishing mortality rate in the NNJ region that would result from an annual catch equal to the annual production of biomass by that region. F_{PO} is recommended as an overfishing target, and the other biological reference points represent options for overfishing thresholds. All of the reference point estimates are sensitive to the value for natural mortality, M, which was assumed = 0.05. There is considerable uncertainty as to the true value of this parameter. If true M > 0.05, then both annual biomass production and F_{PO} are overestimated. Table 1 lists the most recent estimates from SARC-26 (NEFSC 1998a) of surfclam biomass, landings, F and production, by region and across regions. The most recent estimate of F for the NNJ region was 0.04, which is just below F_{PO} .

Exploitation rates in other areas are typically lower than the production rates and population status differs markedly across regions. Production rates tend to be lower in the Delmarva region where dense populations of slower growing individuals have accumulated in the absence of high fishing mortality. In contrast, unfished populations on Georges Bank appear to be accruing biomass each year. Owing to a large difference in primary productivity between these regions, it is not possible to derive simply an empirical biomass dynamics model. Intensive monitoring of regional populations, particularly in response to changing harvest patterns, may be sufficient to elucidate the underlying MSY. Until then, prudent quotas set at levels near current landings should be sustainable and exhibit minor interannual variation.

In regions that are currently unfished, F_{PO} for each region could serve as a reasonable proxy for F_{MSY}. It should be noted, however, that biomass and production levels should not be pooled across regions or years to define a global B_{MSY} and global MSY, respectively. Surfclams are sessile and local overfishing would occur if landings equal to a global MSY were taken from a single region such as NNJ. The regions defined in Table 1 appear to be on the appropriate physical scale for population management. Thus, increases in yield might be achieved from certain regions as long as the yield did not exceed that region's annual production.

In summary, the data are insufficient to estimate B_{MSY} , MSY or F_{MSY}. However, stable yields, absence of change in mean length, successful recruitment, and the rough equivalence of production in NNJ with harvests imply that the current policy is at equilibrium with the resource and may be near the optimum. Finally, it is noted that there is consistency between the current recommendation and earlier modeling results by Murawski and Idoine (1989). Their simulation model of surfclams under exploitation, which incorporated numerous population parameters including variability in recruitment among years, indicated that a constant-catch policy of 45 to 55 million pounds of meats/yr would achieve a balance between yield maximization, low interannual variation in yield, and risk-aversion.

As further justification of the sustainable nature of the resource with these harvest levels, the estimate of MSY in the original FMP was 2.9 million bushels (approximately 50 million pounds of shucked meats) over the range of the resource, which was based on commercial landings from 1960-1976 (MAFMC 1977). In Amendment 8 (MAFMC 1988) the MSY section concludes, after extensive modeling by the NEFSC, that: "In terms of the overall MSY, it appears that the previous estimate of 50 million lbs of shucked clam meats everywhere, is probably the best current estimate for the mid-Atlantic EEZ surfclam population."

In conclusion, the new overfishing definition "target" for surfclams will be the 1997 biomass estimate for Northern New Jersey (NNJ) as a reasonable proxy for B_{MSY} and the associated F_{PO} (replacement level) level of fishing mortality that would result from an annual catch equal to the annual production of biomass by that NNJ region. The overfishing definition "threshold" would be ½ the B_{MSY} proxy (as recommended by the Applegate *et al.* 1998 Overfishing Definition Review Panel report) with an $F_{20\%MSP}$ level of fishing mortality that should never be exceeded. The $F_{20\%}$ MSP level is the threshold level recommended by the NEFSC for Amendment 9 (MAFMC 1996) and reviewed and approved by the MAFMC Scientific and Statistical Committee.

For MSY of ocean quahogs, it is generally assumed that MSY for harvested populations occurs at one-half the virgin biomass. The 1997 surveyed biomass estimate (roughly 3 billion pounds of meats) is at about 80% of the virgin biomass (roughly 4 billion pounds of meats) and exploitation rates are below $F_{0.1}$, $F_{25\%}$, and F_{max}. The combination of current biomass and F is highly unlikely to represent overfishing, as defined by the current SFA guidelines (NEFSC 1998b). There is however, significant time to determine the exact nature of the sustainability of the resource, since total removals (which have averaged about 40 million pounds/year) over the past two decades have only reduced the virgin biomass by about 20%.

The current biomass is less than the likely carrying capacity of the resource, but well above K/2. Moreover, the current fishing mortality rates are well below existing fishing mortality rate thresholds. Current status of the ocean quahog resource is schematically depicted in Figure 8. The 1997 surveyed biomass estimate (roughly three billion pounds) is at about 80% of the virgin biomass (roughly four billion pounds). This figure suggests that fishing mortality rates are below two alternative action levels and that overall population biomass exceeds levels which would require rebuilding. Nonetheless, 22 years of harvesting appear to have reduced the population in some areas. It is not yet possible to characterize the dynamic response of the population to these decreases in density. In many instances, the recruits that might have been produced as a result of prior reductions are only now becoming vulnerable to the survey dredge. Thus, some caution is necessary in the interpretation of Figure 8.

In conclusion, the overfishing definition "target" for ocean quahogs is one-half the virgin biomass and the $F_{0.1}$ level of fishing mortality for the exploited region. The overfishing definition "threshold" would be one-half B_{MSY} or one-quarter of the virgin biomass (as recommended by the Applegate *et al.* 1998 Overfishing Definition Review Panel report) with an $F_{25\%MSP}$ level of fishing mortality that should never be exceeded. The $F_{25\%}$ MSP level is the threshold level recommended by the NEFSC for Amendment 9 (MAFMC 1996) and reviewed and approved by the MAFMC Scientific and Statistical Committee. Annual quotas will be specified which correspond roughly to the target fishing mortality rate. Quotas will be set annually by the Regional Administrator according to the FMP.

3.1.3.2 Conservation and management measures shall be based upon the best scientific information available.

This FMP is based on the best and most recent scientific information available. Data used include NMFS logbook and permit files and the most recent stock assessments (NEFSC 1998a and 1998b). Surfclam and ocean quahog assessments should continue to be performed after each NMFS survey. Significant time and effort was devoted to the essential fish habitat section by NMFS scientists and staff over the past year.

3.1.3.3 To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

No need to change this section at this time. The management unit is all surfclams and all ocean quahogs in the Atlantic EEZ.

3.1.3.4 Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (a) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and © carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

No need to change this section at this time. The FMP does not discriminate among residents of different states. It does not differentiate among US citizens, nationals, resident aliens, or corporations on the basis of their state of residence. It does not incorporate or rely on a state statute or regulation that discriminates against residents of another state.

3.1.3.5 Conservation and management measures shall, where practicable, consider efficiency in the utilization of the fishery resources; except that no such measure shall have economic allocation as its sole purpose.

No need to change this section at this time. The management regime is intended to allow the fishery to operate at the lowest possible cost (e.g., fishing effort, administration, and enforcement) given the FMP's objectives.

3.1.3.6 Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

No need to change this section at this time. The Amendment does not alter the FMP's consistency with this standard. The historical catch basis for allocation takes into account and allows variations in catch. The annual quota setting process allows for adjustments to catch levels in response to the condition of the resources.

3.1.3.7 Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

No need to change this section at this time. During the past decade, the ITQ nature of the fishery has minimized government and industries costs associated with the management of these resources.

3.1.3.8 Conservation and management measures shall, consistent with the conservation requirements of the Magnuson-Stevens Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (a) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

A complete description of the ports and their reliance on various species, including Atlantic surfclams and ocean quahogs is given in Section 3.3. The purpose of this Amendment has been to meet the new Congressional mandates associated with the October 1996 Sustainable Fisheries Act. Therefore, several of the fishing communities along the US east coast north of Cape Hatteras will be positively impacted by the FMP, especially in the long run since now there is no possibility of overfishing. The major benefit to be realized through implementation of recent Amendments to this FMP is that overfishing and over-capitalization in these fisheries will be avoided in the future.

The proper management of the stock complexes managed under this FMP through implementation of the management measures described in recent Amendments have been beneficial to the commercial fishing communities of the Atlantic Coast. By preventing overfishing of the stocks and overcapitalization of the industry, positive benefits to the fishing communities have and will continue to be realized.

These proposed management measures take into account the importance of the fishery resources to the fishing communities. The impacts of the proposed actions on participants in the surfclam and ocean quahog fisheries including analyses of biological, economic, and social impacts are described previously, in the next two sections, and in section 4 (Regulatory Impact Review) of the FMP.

The recently implemented (May 1998) Amendment 10 improves the FMP to better enable it to meet this new National Standard. The major thrust of Amendment 10 was to allow small-scale fishing communities on the coast of Maine to continue to operate as they have historically and under the experimental fishery between October 1990 and September 1997. Amendment 8 regulations did not readily provide for the sustained participation of these fishermen nor their communities, nor did it minimize adverse economic impacts. If Amendment 10 had not been implemented, these small-scale fishing boats and the communities with which they are associated would have been significantly impacted.

3.1.3.9 Conservation and management measures shall, to the extend practicable, (a) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

The Sustainable Fisheries Act (SFA), which reauthorized and amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) made a number of changes to the existing National Standards, as well as to definitions and other provisions an the Magnuson-Stevens Act. In regard to National Standard 9, the SFA requires that bycatch issues must be considered when implementing conservation and management measures.

This National Standard requires Councils to consider the bycatch effects of existing and planned conservation and management measures. Bycatch can, in two ways, impede efforts to protect marine ecosystems and achieve sustainable fisheries and the full benefits they can provide to the Nation. First, bycatch can increase substantially the uncertainty concerning total fishing-related mortality, which makes it more difficult to assess the status of stocks, to set the appropriate optimal yield (OY) and define overfishing levels, and to ensure that OYs are attained and overfishing levels are not exceeded. Second, bycatch may also preclude other more productive uses of fishery resources.

The term "bycatch" means fish that are harvested in a fishery, but that are not sold or kept for personal use. Bycatch includes the discard of whole fish at sea or elsewhere, including economic discards and regulatory discards, and fishing mortality due to an encounter with fishing gear that does not result in capture of fish (i.e., unobserved fishing mortality). Bycatch does not include any fish that legally are retained in a fishery and kept for personal, tribal, or cultural use, or that enter commerce through sale, barter, or trade. Bycatch does not include fish released alive under a recreational catch-and-release fishery management program. a catch-and-release fishery management program is one in which the retention of a particular species is prohibited. In such a program, those fish released alive would not be considered bycatch.

None of the management measures proposed in this Amendment will promote or result in increased levels of bycatch relative to the status quo. An ITQ program, as in these fisheries, reduces the "race to fish" and therefore significantly reduces bycatch of undesirable species.

The surfclam and ocean quahog fisheries are extremely clean, as evidenced by the 1997 NEFSC clam survey species listing (Table 29). Surfclams and ocean quahogs comprise well over 80% of the total catch from the survey, with no fish caught. Only sea scallops, representing other commercially desirable invertebrates were caught at around one-half of one percent.

The range of surfclams and ocean quahogs overlaps with that of marine mammals and endangered species to a large degree, and there always exists some very limited potential for an incidental kill. Except in unique situations (e.g., tuna-porpoise in the central Pacific), such accidental catches should have a negligible impact on marine mammal/endangered species abundance, and the Council does not believe that implementation of this Amendment will have any adverse impact upon these populations. While marine mammals may occur near surfclam and ocean quahog beds, it is highly unlikely any significant conflict between the fishermen managed by this Amendment and these species would occur. Commercial clam dredging vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. Additionally, surfclams and ocean quahogs are benthic organisms, while marine mammals and marine turtles are pelagic and spend nearly all of their time up in the water column or near the surface. The realized reduction in the number of fishing vessels resulting from Amendment 8 reduced the potential for the interaction with endangered species from a minimal to a very minimal level. Furthermore, management of these two bivalves are in the EEZ only, except for the zone in eastern Maine and the only listed endangered fish species, shortnose sturgeon, practically never ventures far from its riverine existence. Bycatch in eastern Maine clam dredges of fish species is extremely minimal (Finlayson pers. comm.). Observations made during the PSP sampling program by the Maine Department of Marine Resources indicate negligible bycatch in the Maine fishery (McGowan pers. comm.).

3.1.3.10 Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

The Sustainable Fisheries Act (SFA), which reauthorized and amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), made a number of changes to the existing National Standards, as well as to definitions and other provisions an the Magnuson-Stevens Act. In regard to National Standard 10, the SFA requires that the safety of human life at sea must be promoted when implementing conservation and management measures.

National Standard 10 recognizes that fishery regulations by definition place constraints on fishing that would not otherwise exist. It's purpose is to ensure that fishery regulations do not create pressures on fishermen to fish under conditions they would otherwise avoid. None of the management measures in the current FMP promote or result in increased levels of unsafe behavior at sea.

None of the management measures proposed in this preferred alternative will promote or result in increased levels of unsafe behavior at sea relative to the status quo. The proposed management measures of this Amendment do not limit the times or places when or where vessels may fish. Therefore, the Council has concluded that the proposed Amendment will not affect the safety of vessels fishing in this fishery.

Currently Georges Bank is closed to fishing because of PSP problems for both surfclams and ocean quahogs. Over one quarter of each resource is located on Georges Bank and therefore perhaps the vessels do not have as large of an area to fish as they would have if Georges were opened. However, the clam fishery on Georges Bank has never been extensive and is likely the location with the greatest danger to fishermen. If and when fishermen need that resource, it is anticipated that they will have the clams tested for PSP and may be able to fish there.

Amendment 8 with the implementation of ITQs went far in promoting safety at sea over the previous management regime which focused on effort restrictions. There is no reason why this ITQ fishery is anything but one of the safest commercial fisheries in the entire world.

The Council developed this FMP and subsequent Amendments with the consultation of industry advisors to help ensure that this was the case. In summary, the Council has concluded that the proposed Amendment will not impact or affect the safety of human life at sea. Therefore, National Standard 10 is met.

3.1.4 Analysis of the Preferred Management Measures

3.1.4.1 Introduction

This section presents an analysis of the impacts of the preferred management measurers considered by the Council. These actions were described above in section 3.1.1. In this section each management measure is analyzed in terms of biological impacts, economic impacts, social impacts, and its effects to marine mammals, turtles, and sea birds. The alternative to the preferred management measures was described and analyzed in section 3.1.2 above and is analyzed in section 3.1.5 below. This Amendment includes new overfishing definitions and identifies and describes essential fish habitat. No management measures are proposed for either of these two issues. Management measures are only proposed for the framework adjustment process and the requirement of Operator Permits.

3.1.4.2 Revised definitions of overfishing

Biological Impacts

Neither surfclams nor ocean quahogs are overfished, nor do they appear likely to be in the near future. Council policy is to set annual quotas within an OY range (section 3.1.1.1 The OY will never exceed the MSY.) for surfclams between 1,850,000 and 3,400,000 bushels (31.5 to 57.8 million pounds of meats) and for ocean quahogs between 4.0 and 6.0 million bushels (40 to 60 million pounds of meats). There is no reason to change the OY range based upon the new overfishing definitions. Therefore there is no reason that these new overfishing definitions will have any biological impacts.

Social and Economic Impacts

There is no reason to change the OY range based upon the new overfishing definitions. Therefore there is no reason that these new overfishing definitions will have any new social or economic impacts. The quota recommendations that the Council submits to the Regional Administrator every year have a full evaluation of the quota and the upper and lower ranges considered. An EA and an RIR are generated annually in association with the quota recommendations.

Effects on Marine Mammals, Sea Turtles and Seabirds

No management measures are necessary since these two resources are not overfished. The fishery will continue to operate as it has in the past with minimum interaction with endangered species.

Activities conducted under this Amendment have not yet been considered for their impacts on endangered species in order to do a Section 7 of the Endangered Species Act consultation. The NMFS will be performing a Section 7 consultation while the Amendment is out for public review during the next few months. The Fish and Wildlife Service may also perform a Section 7 consultation on any seabirds that may be impacted by this Amendment. The following background information is provided to facilitate evaluations of the alternatives relative to the order of magnitude these commercial surfclam and ocean quahog fisheries may have on these threatened or endangered species.

Numerous species of marine mammals and sea turtles occur in the northwest Atlantic Ocean. The most recent comprehensive survey in this region was done from 1979-1982 by the Cetacean and Turtle Assessment Program (CETAP), at the University of Rhode Island (University of Rhode Island 1982), under contract to the Minerals Management Service (MMS), Department of the Interior. The following is a summary of the information gathered in that study, which covered the area from Cape Sable, Nova Scotia, to Cape Hatteras, North Carolina, from the coastline to 5 nautical miles seaward of the 1000 fathom isobath.

Four hundred and seventy one large whale sightings, 1547 small whale sightings and 1172 sea turtles were encountered in the surveys (Table 30). The "estimated minimum population number" for each mammal and turtle in the area, as well as those species currently included under the Endangered Species Act, were also tabulated.

CETAP concluded that both large and small cetaceans were widely distributed throughout the study area in all four seasons, and grouped the 13 most commonly seen species into three categories, based on geographical distribution. The first group contained only the harbor porpoise, which is distributed only over the shelf and throughout the Gulf of Maine, Cape Cod, and Georges Bank, but probably not southwest of Nantucket. The second group contained the most frequently encountered baleen whales (fin, humpback, minke, and right whales) and the white-sided dolphin. These were found in the same areas as the harbor porpoise, and also occasionally over the shelf at least to Cape Hatteras or out to the shelf edge. The third group indicated a "strong tendency for association with the shelf edge" and included the grampus, striped, spotted, saddleback, and bottlenose dolphins, and the sperm and pilot whales.

Loggerhead turtles were found throughout the study area, but appeared to migrate north to about Massachusetts in summer and south in winter. Leatherbacks appeared to have had a more northerly distribution. CETAP hypothesized a northward migration of both species in the Gulf Stream with a southward return in continental shelf waters nearer to shore. Both species usually were found over the shoreward half of the slope and in depths less than 200 feet. The northwest Atlantic may be important for sea turtle feeding or migrations, but the nesting areas for these species generally are in the South Atlantic and Gulf of Mexico.

This problem may become acute when climatic conditions result in concentration of turtles and fish in the same area at the same time. These conditions apparently are met when temperatures are cool in October but then remain moderate into mid-December and result in a concentration of turtles between Oregon Inlet and Cape Hatteras, North Carolina. In most years sea turtles leave Chesapeake Bay and filter through the area a few weeks before the bluefish becomes concentrated. Efforts are currently under way (by VIMS and the U.S. Fish and Wildlife Service refuges at Back Bay, Virginia, and Pea Island, North Carolina) to more closely monitor these mortalities due to trawls. Fishermen are encouraged to carefully release turtles captured incidentally and to attempt resuscitation of unconscious turtles as recommended in the 1981 *Federal Register* (pages 43976 and 43977).

The only endangered species of fish occurring in the northwest Atlantic is the shortnose sturgeon (*Acipenser brevirostrum*). The Councils urge fishermen to report any incidental catches of this species to the Regional Administrator, NMFS, One Blackburn Drive, Gloucester, Massachusetts 01930, who will forward the information to persons responsible for the active sturgeon data base.

The range of surfclams and ocean quahogs and the above mentioned marine mammals and endangered species overlap and there always exists a potential for an incidental kill. Except in unique situations, such accidental catches should have a negligible impact on marine mammal or abundances of endangered species, and the Councils do not believe that implementation of this FMP will have any adverse impact upon these populations.

Attempts were made to put these fisheries/sea turtle interaction into perspective of other sources of mortality for these endangered turtle species. The Congressionally mandated report *Decline of the Sea Turtles: Causes and Prevention* states that "Of all the known factors, by far the most important source of deaths was the incidental capture of turtles (especially loggerheads and Kemp's ridleys) in shrimp trawling. This factor acts on the life stages with the greatest reproductive value for the recovery of sea turtle populations."

Mortality associated with other fisheries and with lost or discarded fishing gear is much more difficult to estimate than that associated with shrimp trawling, and there is a need to improve these estimates. This report identified possible turtle losses from the winter trawl fishery north of Cape Hatteras (about 50-200 turtles per year); the historical Atlantic sturgeon fishery, now closed, off the Carolinas (about 200 to 800 turtles per year); and the Chesapeake Bay passive-gear fisheries (about 25 turtles per year). Considering the large numbers of fisheries from Maine to Texas that have not been evaluated and the problems of estimating the numbers of turtles entangled in the 135,000 metric tons of plastic nets, lines, and buoys lost or discarded annually, it seems likely that more than 500 loggerheads and 50 Kemp's ridleys are killed annually by nonshrimp fisheries (NRC 1990). These other fishery operations, lost fishing gear, and marine debris are known to kill sea turtles, but the reported deaths are only about 10% of those caused by shrimp trawling. Dredging, entrainment in power-plants intake pipes, collisions with boats, and the effects of petroleum-platform removal all are potentially and locally serious causes of sea turtle deaths. However these collectively amount to less than 5% of the mortality caused by shrimp trawling (NRC 1990).

The Congressionally mandated report concludes that all species of marine turtles need increased protection under the Endangered Species Act and other relevant legislation. While the report does not recommend specific conservation measures for these fisheries, the recommendations for the shrimp trawling are germane. The report recommended TEDs, 60 minute winter tow-time limits, and limited time/area closure for turtle "hot spots". Currently, there are 5 sea turtle recovery plans in place, these include plans for the loggerhead (1991), the green sea turtle (1991), the leatherback (1992), the Kemp's ridley sea turtle (1992), and the hawksbill sea turtle (1993). Of the six "Actions Needed" that are identified by the Recovery Plan to achieve recovery of loggerheads is item 5: "minimize mortality from commercial fisheries."

Shortnose sturgeon (*Acipenser brevirostrum*) is an additional endangered species that may be caught incidentally in trawl fisheries. Sturgeon will be included in the Incidental Take Statement of the pending Biological Opinion. As shortnose sturgeon are generally associated with the estuarine environment, rather than the truly marine environment, it is anticipated that the gear and fishing locations of these surfclam and ocean quahog fisheries will rarely encounter shortnose sturgeon.

Marine mammals are managed under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. Marine mammals have been historically important in the U.S. both as targets for commercial harvests and in ecological interactions with commercial fisheries.

The results of this earlier work was addressed in 1979 when the U.S. Marine Mammal Commission sponsored a workshop to help define research needed for the study of marine mammals on the U.S. east and Gulf coasts and in 1989 at a NMFS-sponsored workshop on Gulf of Mexico marine mammal research needs (USDC 1993b). These workshops set a research agenda that was immediately addressed by agencies such as the Minerals Management Service and the NMFS. During the 1980's, several institutions in the northeast developed active research programs which have resulted in a body of knowledge that is being drawn upon in developing management approaches for several critical marine mammal issues in the region. In the 1990's, increased attention has been focused on the characterization of marine mammal fauna of the U.S. Gulf of Mexico and the Mid-Atlantic Bight (USDC 1993b).

Thirty-five species of marine mammals range the U.S. Atlantic and Gulf of Mexico waters (32 whales, dolphins and porpoises, two seal species and one manatee). Their status, in general, is poorly known, but some, like the right whale, Mid-Atlantic coastal bottlenose dolphin, and harbor porpoise, are under stresses that may affect their survival (USDC 1993b).

The gears managed under this FMP are all in the third category or not listed at all for the final List of Fisheries for 1997 for the taking of marine mammals by commercial fishing operations under section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Section 114 of the MMPA establishes an interim exemption for the taking of marine mammals incidental to commercial fishing operations and requires NMFS to publish and annually update the List of Fisheries, along with the marine mammals and the number of vessels or persons involved in each fishery, arranging them according to categories, as follows:

1. a fishery that has a frequent incidental taking of marine mammals;

2. a fishery that has an occasional incidental taking of marine mammals; or

3. a fishery that has a remote likelihood, or no known incidental taking, of marine mammals.

In Category I there is documented information indicating a "frequent" incidental taking of marine mammals in the fishery. "Frequent" means that it is highly likely that more than one marine mammal will be incidentally taken by a randomly selected vessel in the fishery during a 20-day period. No surfclam or ocean quahog fisheries are in this category.

In Category II there is documented information indicating an "occasional" incidental taking of marine mammals in the fishery, or in the absence of information indicating the frequency of incidental taking of marine mammals, other factors such as fishing techniques, gear used, methods used to deter marine mammals, target species, seasons and areas fished, and species and distribution of marine mammals in the area suggest there is a likelihood of at least an "occasional" incidental taking in the fishery. "Occasional" means that there is some likelihood that one marine mammal will be incidentally taken by a randomly selected vessel in the fishery during a 20-day period, but that there is little likelihood that more than one marine mammal will be incidentally taken. No surfclam or ocean quahog fisheries are in this category.

In Category III there is information indicating no more than a "remote likelihood" of an incidental taking of a marine mammal in the fishery or in the absence of information indicating the frequency of incidental taking of marine mammals, other factors such as fishing techniques, gear used, methods used to deter marine mammals, target species, seasons and areas fished, and species and distribution of marine mammals in the area suggest there is no more than a remote likelihood of an incidental take in the fishery. "Remote likelihood" means that it is highly unlikely that any marine mammal will be incidentally taken by a randomly selected vessel in the fishery during a 20-day period. The mixed species trawl fishery (where most bluefish are commercially caught) is considered a Category III fishery. No surfclam or ocean quahog fisheries are in this category.

It is slightly possible that pelagic seabirds may also come into contact with fisheries. Most of the following information is taken from the Mid-Atlantic Regional Marine Research Program (1994). Fulmars occur as far south as Virginia in late winter and early spring. Shearwaters, storm petrels (both Leach's and Wilson's), jaegers, skuas and some terns pass through this region in their annual migrations. Gannets and phalaropes occur in the Mid-Atlantic during winter months. Eight gulls breed in eastern North America and occur in shelf waters off the northeastern U.S. These gulls include: glaucous, Iceland, great black-backed, herring, laughing, ring-billed, Bonaparte's and Sabine's gulls and black-legged caduceus. Royal and sandwich terns are coastal inhabitants from Chesapeake Bay south to the Gulf of Mexico. The Roseate tern is listed as endangered under the ESA, while the Least tern is considered threatened (Safina pers. comm.). Of course, our national symbol, the bald eagle is listed as endangered under the ESA, and is a bird of aquatic ecosystems. Literally translated, its Latin name, *Haliaeetus leucocephalus*, means white-headed sea eagle (*Federal Register* 1994, 35584).

Surfclams and ocean quahogs are not important prey for the Common and Roseate terns (Safina 1987, Safina *et al.* 1988, and Safina *et al.* 1990). Safina *et al.* (1988) note that few other seabird studies have measured ambient food levels among foraging birds, but many studies which have examined food provisioning to chicks and reproductive performance in seabirds have found results similar to theirs. Laying dates, clutch sizes, growth, and fledgling success of seabirds have been linked to food availability by a number of workers. Safina *et al.* (1988) recorded that prey fish were more abundant in 1984 than it was in 1985 and noted that reproductive productivity of terns was greater in 1984 for most parameters measured. Although they studied productivity for only two seasons, the results suggest that prey population fluctuations may limit reproductive success in the terns they studied.

Safina *et al.* (1990) noted that observing prey deliveries at nests cannot address the question of how foraging birds select prey or foraging habitat from the range of possibilities. However, the variability they found show that either prey availability or birds' selection criteria changes, and that prey availability or selection varies differently between the two tern species, Common and Roseate, they studied. Some prey species may have their own consistent internal rhythms (or influencing factors) which make them differentially susceptible to tern predation on a daily time scale.

A definitive analyses of the importance of surfclams or ocean quahogs for the diets of pelagic seabirds and marine mammals has not yet been conducted. Alaska Sea Grant (1993) sponsored a workshop in 1993 entitled *Is It Food* which addressed the importance of Alaskan fish prey for marine mammal and seabird declines. A similar workshop for Northwest Atlantic interactions would be quite germane.

Preventing overfishing of surfclams and ocean quahogs may be beneficial to some seabirds and certain species of marine mammals.

3.1.4.3 Framework adjustment process and EFH

<u>Biological Impacts</u>

The framework adjustment process and EFH do not have any management measures proposed for them in this Amendment and therefore will not have any new biological impacts.

<u>Economic and Social Impacts</u>

The framework adjustment process and EFH do not have any management measures proposed for them in this Amendment and therefore will not have any new economic or social impacts.

Effects on Marine Mammals, Sea Turtles and Seabirds

The framework adjustment process and EFH do not have any management measures proposed for them in this Amendment and therefore will not have any changes to the fishery. Thus, the fishery will continue to operate as it has in the past with minimum interaction with endangered species.

3.1.4.4 Operator permits

Biological Impacts

The implementation of Operator Permits will not have any management measures proposed that will have any new biological impacts.

Economic and Social Impacts

The implementation of operator permits will effect only a few fishermen (most fishermen already have them for other fisheries) and therefore will not have any major new economic or social impacts. The minimal costs associated with Operator Permits are described in section 4.

Effects on Marine Mammals, Sea Turtles and Seabirds

The implementation of operator permits will not have any management measures proposed that will have any new impacts for the fishery and therefore it will continue to operate as it has in the past with minimum interaction with endangered species.

3.1.5 Analysis of the Alternatives to the Preferred Management Measures

3.1.5.1 Take No Action

Only the "no action" alternative is considered in order to meet the NEPA requirements. Under this alternative, the definitions of overfishing for both species managed under this FMP would remain unchanged from Amendment 9 and would not include a biomass estimate. In addition, the framework process described in the above section would not be implemented to address future management problems. The mandates of the 1996 Sustainable Fisheries Act (essential fish habitat, safety at sea, communities, and bycatch) would not be addressed. The surfclam and ocean quahog fishery would remain as one of only two MAFMC FMPs that does not require Operator Permits.

Biological Impacts

Without the implementation of the new overfishing definitions and description and identification of EFH the surfclam and ocean quahog resources could possibly be overfished and their EFH could be negatively impacted.

Economic and Social Impacts

The description and identification of EFH will help protect and improve a healthy environment which will benefit fishermen and a wide array of other users. Groups that would spoil a healthy environment may be negatively impacted by the identification and description of EFH, however it is Congressionally mandated so the Council must comply.

Effects on Marine Mammals, Sea Turtles and Seabirds

Without the new definitions of overfishing and the identification and description of EFH that is provided in the preferred alternative, these protected species are less likely to be protected and rebuild.

3.2 EFFECTS OF FISHERY ON THE ENVIRONMENT

3.2.1 Effects of fishing gear

Fishing gear impacts on essential surfclam and ocean quahog habitat is discussed in section 2.2.3.

3.2.2 Effect on endangered species and on the coastal zone

The relationships among this Amendment and various existing applicable laws and policies are fully described in section 5.0. By preventing overfishing of these species the chances that their populations will be reduced due to fishing will be greatly diminished. This should have a positive effect on marine predators which may utilize somewhat these species as prey. The overall effect on marine mammals should be positive relative to the current specifications.

The Coastal Zone programs for the States between Maine and North Carolina will be reviewed relative to this Amendment for Coastal Zone Consistency. Letters will be addressed to those states while this document is out for public review.

3.2.3 Effects on flood plains or wetlands

The adopted management measures or their alternatives will not adversely affect flood plains or wetlands, and trails and rivers listed or eligible for listing on the National Trails and Nationwide Inventory of Rivers. Management of these species are in the EEZ only.

3.2.4 List of agencies, organizations, and persons consulted in formulating the proposed action

In preparing the Amendment, the Council consulted extensively with the NMFS, the New England Fishery Management Council, the Fish and Wildlife Service, and the States of New York, New Jersey, Pennsylvania, Delaware, Maryland, North Carolina, and Virginia through their membership on the Council. In addition to the States that are members of this Council, Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut were also consulted through the Coastal Zone Management Program consistency process.

3.2.5 Findings of no significant environmental impact

For the reasons discussed above, it is hereby determined that neither approval and implementation of the proposed action nor the alternative would affect significantly the quality of the human environment, and that the preparation of an environmental impact statement on the Amendment is not required by Section 102(2)(c) of the National Environmental Policy Act nor its implementing regulations.

Assistant Administrator for Fisheries, NOAA   Date

4.0 REGULATORY IMPACT REVIEW AND REGULATORY FLEXIBILITY ANALYSIS

4.1 INTRODUCTION

The National Marine Fisheries Service (NMFS) requires the preparation of a Regulatory Impact Review (RIR) for all regulatory actions that either implement a new Fishery Management Plan (FMP) or significantly amend an existing plan. The RIR is prepared by the Regional Fishery Management Councils with assistance from the National Marine Fisheries Service (NMFS), as necessary. The RIR is part of the process of preparing and reviewing FMPs and provides a comprehensive review of the level and incidence of economic impact associated with proposed regulatory actions. The analysis also provides a review of the problems and policy objectives prompting the regulatory proposals and an evaluation of the major alternatives that could be used to solve the problems. The purpose of the analysis is to ensure that the regulatory agency systematically and comprehensively considers all available alternatives so that the public welfare can be enhanced in the most efficient and cost-effective way.

The National Marine Fisheries Service requires a RIR for all regulatory actions that are part of public interest. The RIR does three things: 1) it provides a comprehensive review of the level and incidence of impacts associated with a proposed or final regulatory action; 2) it provides a review of the problems and policy objectives prompting the regulatory proposals and an evaluation of the major alternatives that could be used to the problem; and 3) it ensures that the regulatory agency systematically and comprehensively considers all available alternatives so public welfare can be enhanced in the most efficient and cost effective way.

The RIR addresses many items in the regulatory philosophy and principles of Executive Order (E.O.) 12866. The RIR also serves as the basis for determining whether any proposed regulation is a "significant regulatory action" under certain criteria provided in E.O. 12866 and whether the proposed regulations will have a significant economic impact on a substantial number of small entities in compliance with Regulatory Flexibility Act of 1980 (RFA) as amended by Public Law 104-121. The purpose of the RFA is to relieve small businesses, small organizations, and small government entities from burdensome regulations and record keeping requirements, to the extent possible.

4.2 PROBLEMS AND OBJECTIVES

4.2.1 Problems Addressed by the Amendment

The Sustainable Fisheries Act of October 1996 (SFA), which reauthorized and amended the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), made a number of changes to the existing National Standards, as well as to definitions and other provisions in the Magnuson-Stevens Act, that caused the Guidelines to be significantly revised.

The SFA revised National Standard 1 and added three new National Standards, including requirements that FMPs take into consideration the effects on fishing communities (National Standard 8), reduce bycatch (National Standard 9), and promote safety of life at sea (National Standard 10). In addition, the SFA requires the Councils to identify and describe essential habitat for species managed under the SFA. The purpose of this Amendment is to bring the Atlantic Surfclam and Ocean Quahog Fishery Management Plan into compliance with the new and revised National Standards and other required provisions of the Sustainable Fisheries Act. There are no management measures proposed in this Amendment relative to overfishing, rebuilding, EFH, fishing communities, bycatch, or safety at sea.

4.2.1.1 New Overfishing Definitions

4.2.1.1.1 Atlantic surfclams

The present data are insufficient to estimate accurately B_{MSY} , MSY, or F_{MSY} (section 2.1.4). However, stable yields, absence of change in mean length, successful recruitment, and the rough equivalence of production in NNJ with harvests imply that the current policy is at equilibrium with the resource and is likely near the optimum.

The new overfishing definition "target" for surfclams will be the 1997 biomass estimate for Northern New Jersey (NNJ) as a reasonable proxy for B_{MSY} and the associated F_{PO} (replacement level) level of fishing mortality that would result from an annual catch equal to the annual production of biomass by that NNJ region. The overfishing definition "threshold" would be ½ the B_{MSY} proxy (as recommended by the Applegate *et al.* 1998 Overfishing Definition Review Panel report) with an $F_{20\%}$ MSP level of fishing mortality that should never be exceeded. The $F_{20\%}$ MSP level is the threshold level recommended by the NEFSC for Amendment 9 (MAFMC 1996) and reviewed and approved by the MAFMC Scientific and Statistical Committee.

4.2.1.1.2 Ocean quahogs

For MSY of ocean quahogs, it is generally assumed that MSY for harvested populations occurs at one-half the virgin biomass. The 1997 surveyed biomass estimate (roughly 3 billion pounds of meats) is at about 80% of the virgin biomass (roughly 4 billion pounds of meats) and exploitation rates are below $F_{0.1}$, $F_{25\%}$, and F_{max}. The combination of current biomass and F is highly unlikely to represent overfishing, as defined by the current SFA guidelines (NEFSC 1998b). There is however, significant time to determine the exact nature of the sustainability of the resource, since total removals (which have averaged about 40 million pounds/year) over the past two decades have only reduced the virgin biomass by about 20%.

The overfishing definition "target" for ocean quahogs is one-half the virgin biomass and the $F_{0.1}$ level of fishing mortality for the exploited region. The overfishing definition "threshold" would be one-half B_{MSY} or one-quarter of the virgin biomass (as recommended by the Applegate *et al.* 1998 Overfishing Definition Review Panel report) with an $F_{25\%}$ level of fishing mortality that should never be exceeded. The $F_{25\%}$ MSP level is the threshold level recommended by the NEFSC for Amendment 9 (MAFMC 1996) and reviewed and approved by the MAFMC Scientific and Statistical Committee.

4.2.1.2 Essential Fish Habitat Definition

The SFA significantly altered the requirement of FMPs to address habitat issues. The SFA contains provisions for the identification and protection of habitat essential to the production of federally managed species. The act requires FMPs to include identification and description of essential fish habitat (EFH), description of non-fishing and fishing threats, and suggest conservation and enhancement measures. These new habitat requirements are addressed in this Amendment in section 2.2.

4.2.1.2.1 Surfclams: Throughout the substrate, to a depth of three feet below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of all the ranked ten-minute squares for the area where surfclams were caught in the NEFSC surfclam and ocean quahog dredge surveys (Figure 16). Surfclams generally occur from the beach zone to a depth of about 200 feet, but beyond about 125 feet abundance is low.

4.2.1.2.2 Ocean quahogs: Throughout the substrate, to a depth of three feet below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ, in areas that encompass the top 90% of all the ranked ten-minute squares for the area where ocean quahogs were caught in the NEFSC surfclam and ocean quahog dredge surveys (Figure 17). Distribution in the western Atlantic ranges in depths from 30 feet to about 800 feet. Ocean quahogs are rarely found where bottom water temperatures exceed 60 °F, and occur progressively further offshore between Cape Cod and Cape Hatteras.

The management measures adopted by the Council for this Amendment are:

4.2.1.3 Framework Adjustment Process

In addition to the annual review and modifications to management measures associated with the quota setting process, the Council would like to be able to add or modify management measures through a framework adjustment procedure. This adjustment procedure allows the Council to add or modify management measures through a streamlined public review process. As such, management measures that have been identified in the plan could be implemented or adjusted at any time during the year.

4.2.1.4 Operator Permit

An operator of a vessel with a permit issued pursuant to this FMP must have an Operator's Permit issued by NMFS. Any vessel fishing commercially for surfclams or ocean quahogs in the EEZ must have on board at least one operator who holds a permit. That operator may be held accountable for violations of the fishing regulations and may be subject to a permit sanction. During the permit sanction period, the individual operator may not work in any capacity aboard a federally permitted fishing vessel.

4.2.2. Objectives

The objectives of the Atlantic Surfclam and Ocean Quahog Fishery Management Plan (FMP) are:

1. Conserve and rebuild Atlantic surfclam and ocean quahog resources by stabilizing annual harvest rates throughout the management unit in a way that minimizes short term economic dislocations.

2. Simplify to the maximum extent the regulatory requirement of clam and quahog management to minimize the government and private cost of administering and complying with regulatory, reporting, enforcement, and research requirements of clam and quahog management.

3. Provide the opportunity for industry to operate efficiently, consistent with the conservation of clam and quahog resources, which will bring harvesting capacity in balance with processing and biological capacity and allow industry participants to achieve economic efficiency including efficient utilization of capital resources by the industry.

4. Provide a management regime and regulatory framework which is flexible and adaptive to unanticipated short term events or circumstances and consistent with overall plan objectives and long term industry planning and investment needs.

4.3 METHODOLOGY AND FRAMEWORK FOR ANALYSIS

The basic approach adopted in this RIR is an assessment of management measures from the standpoint of determining the resulting changes in costs and benefits to society. The net effects should be stated in terms of producer and consumer surpluses for the harvesting, processing/dealer sectors, and for consumers. Ideally, the expected present values of net yield streams over time associated with different alternatives should be compared in evaluating the impacts. However, lack of data precludes this type of analysis. The approach taken in analyzing the alternative management actions is to describe and/or quantify to the extent possible the changes in net benefits.

4.4 IMPACTS OF THE PROPOSED ACTIONS AND ALTERNATIVES TO THE AMENDMENT

The proposed management actions and the alternative management actions in this Amendment were discussed in the integrated portion of this document (section 3.1) and are summarized below.

4.4.1 Summary of Impacts of Proposed Actions

Amendment 12 would: 1) revise the definitions of overfishing for each species in the management unit, 2) establish a framework mechanism to allow timely adjustments to management measures as necessary in the future, and 3) establish an Operator Permit for vessels fishing for surfclams or ocean quahogs in the EEZ. The purpose of this summary is to briefly describe the expected economic impacts of the preferred actions considered in this Amendment.

4.4.1.1 Overfishing Definitions

The results of the most recent stock assessments for the surfclam resource found that it "is at a medium level of biomass and is probably under-exploited overall." The ocean quahog resource was "considered under-exploited at the scale of the management unit."

Revision of the overfishing definitions is not anticipated to alter fishing practices or harvest levels in the surfclam and ocean quahog fisheries. Therefore, no economic impact is anticipated.

4.4.1.2 Establish Framework Management Mechanisms

In an effort to make the management process more efficient and reduce costs, the Council is requesting that framework management mechanisms be introduced into all fishery management plans. This adjustment procedure would allow the Council to add or modify management measures through a streamlined public review process. As such, management measures that have been identified in the plan could be implemented or adjusted at any time during the year. Full details of the process are discussed in Section 3.1.1.4.

While expediting the management process, the Council must still provide appropriate justifications, as well as the necessary biological and economic analyses to accompany the framework action when they are submitted. This measure simply enables the Council to engage in such an action at a future date. Therefore, no economic impact is anticipated from adoption of framework management authority in this Amendment.

4.4.1.3 Operator Permits

The Surfclam and Ocean Quahog Fishery Management Plan is one of only two remaining FMPs (summer flounder is the other) in the Northeast to not have implemented Operator Permits. It is very likely, therefore, that most vessel operators will already have obtained permits in order to have the ability to pilot vessels in pursuit of other fisheries. According to NMFS clam vessel logbook records, a total of 84 vessels harvested either surfclams or ocean quahogs in 1997. Thirty-four of those vessels participated in the Maine ocean quahog fishery, and 50 harvested surfclams or ocean quahogs in the ITQ fishery outside of Maine. For the purpose of this analysis, it is assumed that 25% of these vessels do not already have operator permits, or a total of 21 vessels. This estimate is thought to be conservative, since the majority of Maine vessels are known to participate in the ocean quahog fishery only seasonally, and will fish for scallops, lobsters, or urchins at other times of the year.

It is common practice for vessels to have two individuals on board holding operator permits, in case one becomes ill or unavailable. This will result in the need for (2 x 21 vessels) or 42 new operator permits.

4.4.1.3.1 Costs to the Public

There is no fee charged for obtaining an Operator Permit, so the costs to the public are comprised of the value of an individual's time in completing the necessary form, and supplying two photographs. The response time is estimated to be 1 hour for preparation of the form. Using $15 per hour as the accepted valuation of a respondent's time, this would equate to (42 operators x $15 per hour x 1 hour) or $630. Assuming the cost of supplying two photographs would be an additional $7 per operator, this would add $294 to the overall costs. Summing the $630 and $294 costs together results in a total estimated cost of $924 to the public for Operator Permits.

4.4.1.3.2 Costs to the Government

The Northeast Regional Office of NMFS in Gloucester is responsible for issuing Operator Permits to individuals participating in the federal surfclam and ocean quahog fisheries. The Permit Office has laminating equipment in-house for the purpose of issuing Operator Permits, and provided the figure of $10.00 as the average cost of issuing an operator permit (Gouveia pers. comm.). For issuing an estimated total of 42 operator permits, this would result in a total cost of $420 to the federal government.

4.4.2 Summary of Impacts of the Alternatives to the Amendment

Alternative 1 (take no action) will not allow for the FMP to come into compliance with the SFA. As such, the problems identified in section 1.1.3 of this Amendment would not be solved.

4.5 DETERMINATION OF A SIGNIFICANT REGULATORY ACTION

The proposed action does not constitute a significant regulatory action under Executive Order 12866 for the following reasons: (1) It will not have an annual effect on the economy of more than $100 million. Based on unpublished NMFS preliminary data (Maine-Florida), the total commercial value of the surfclam and ocean quahog fishery in 1997 was $51.6 million. The measures considered in this Amendment are not expected to affect total revenues generated by the fishery such that a $100 million annual economic impact could occur. The proposed actions are necessary to protect surfclam and ocean quahog populations from overfishing and allow for management practices that account for variations in the fishery, among others. The proposed action benefits in a material way the economy, productivity, competition, and jobs. The proposed action will not adversely affect, in the long-term, competition, jobs, the environment, public health or safety, or state, local, or tribal government communities. (2) The proposed actions will not create a serious inconsistency or otherwise interfere with an action taken or planned by another agency. No other agency has indicated that it plans an action that will affect the surfclam or ocean quahog fisheries in the EEZ. (3) The proposed actions will not materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of their participants. (4) The proposed actions do not raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

4.6 REVIEW OF IMPACTS RELATIVE TO THE REGULATORY FLEXIBILITY ACT

4.6.1 Introduction

The purpose of the Regulatory Flexibility Act (RFA) is to minimize the adverse impacts from burdensome regulations and record keeping requirements on small businesses, small organizations, and small government entities. The category of small entities likely to be affected by the proposed plan is that of commercial entities harvesting surfclams and ocean quahogs.

The impacts of the proposed action on the fishing industry as a whole were discussed above. The following discussion of impacts centers specifically on the effects of the proposed actions on the mentioned small business entities.

4.6.2 Determination of Significant Economic Impact on a Substantial Number of Small Entities

The Small Business Administration (SBA) defines a small business in the commercial fishing and recreational fishing activity as a firm with receipts (gross revenues) of up to $3.0 million. It is estimated that approximately 84 commercial vessels landed surfclams or ocean quahogs in 1997. All these vessels readily fall within the definition of small business.

According to the guidelines on regulatory analysis of fishery management actions, a "substantial number" of small entities is more than 20 percent of those small entities engaged in the fishery. Since the proposed action will directly and indirectly affect most of these vessels, the "substantial number" criterion will be met.

Economic impacts on small business entities are considered to be "significant" if the proposed action would result in any of the following: 1) a reduction in annual gross revenues by more than 5 percent; 2) an increase in total costs of production by more than 5 percent as a result of an increase in compliance costs; 3) an increase in compliance costs as a percent of sales for small entities at least 10 percent higher than compliance costs as a percent of sales for large entities; 4) capital costs of compliance represent a significant portion of capital available to small entities, considering internal cash flow and external financing capabilities; or 5) as a "rule of thumb," 2 percent of small businesses entities being forced to cease business operations.

4.6.3 Analysis of Economic Impacts

<u>(a) Does this action result in revenue loss of >5 percent for >20 percent or more of the participants?</u>: It is not anticipated that the management measures in this Amendment will have any impact on the revenues of surfclam or ocean quahog fishermen, either positive or negative. The revision of overfishing definitions and allowance for framework management mechanisms are not expected to have a direct impact on the industry. The compliance costs associated with Operator Permits are considered in Item (b) below.

<u>(b) Does the action result in an increase in compliance costs (annualized capital, operating, reporting, etc.) of >5 percent for 20 percent or more of the participants</u>: The costs of compliance with this Amendment are estimated at $22 ($15 form preparation + $7 for 2 photographs) for

those vessel operators who do not have an existing Operator Permit. It has been estimated that 25% of the 1997 surfclam and ocean quahog fleet will fall under this requirement, or a total of 21 individuals. The $22 cost per individual equates to 5% of a figure of $440. While an estimate of annualized capital, operating, and reporting costs is not readily available for the surfclam and ocean quahog industry, is it assumed that a realistic figure for these costs would be on the order of many thousands of dollars. Hence, it is concluded that the 5% threshold for increased compliance costs will not be exceeded by the $22 cost of an Operator Permit.

© Does this action result in 2 percent of the entities ceasing operations: It is not anticipated that this Amendment will have any impact on industry revenues, and hence will not be an impetus for entities ceasing operations.

The preceding analysis of impacts relative to the Regulatory Flexibility Act indicates that, while a substantial number of small entities may be impacted by this action, the proposed management actions in this amendment will not result in significant economic impacts upon a substantial number of such entities. These measures are proposed in order to conserve the surfclam and ocean quahog resources along the Atlantic coast.

5.0 OTHER APPLICABLE LAWS

5.1 RELATION OF RECOMMENDED MEASURES TO EXISTING APPLICABLE LAWS AND POLICIES

5.1.1 FMPs

This FMP is related to other plans to the extent that all fisheries of the northwest Atlantic are part of the same general geophysical, biological, social, and economic setting. U.S. fishermen usually are active in more than a single fishery. Thus, regulations implemented to govern harvesting of one species or a group of related species may impact on other fisheries by causing transfers of fishing effort.

5.1.2 Treaties or International Agreements

No treaties or international agreements, other than GIFAs entered into pursuant to the MSFCMA, relate to this fishery.

5.1.3 Federal Law and Policies

5.1.3.1 Marine mammals and endangered species

Numerous species of marine mammals and sea turtles occur in the northwest Atlantic Ocean. The most recent comprehensive survey in this region was done from 1979-1982 by the Cetacean and Turtle Assessment Program (CETAP), at the University of Rhode Island (University of Rhode Island 1982), under contract to the Minerals Management Service (MMS), Department of the Interior. The following is a summary of the information gathered in that study, which covered the area from Cape Sable, Nova Scotia, to Cape Hatteras, North Carolina, from the coastline to 5 nautical miles seaward of the 1,000 fathom isobath.

Four hundred and seventy one large whale sightings, 1547 small whale sightings and 1172 sea turtles were encountered in the surveys. The "estimated minimum population number" for each mammal and turtle in the area, as well as those species currently included under the Endangered Species Act, were also tabulated (Table 30).

CETAP concluded that both large and small cetaceans were widely distributed throughout the study area in all four seasons, and grouped the 13 most commonly seen species into three categories, based on geographical distribution. The first group contained only the harbor porpoise, which is distributed only over the shelf and throughout the Gulf of Maine, Cape Cod, and Georges Bank, but probably not southwest of Nantucket. The second group contained the most frequently encountered baleen whales (fin, humpback, minke, and right whales) and the white-sided dolphin. These were found in the same areas as the harbor porpoise, and also occasionally over the shelf at least to Cape Hatteras or out to the shelf edge. The third group indicated a "strong tendency for association with the shelf edge" and included the grampus, striped, spotted, saddleback, and bottlenose dolphins, and the sperm and pilot whales.

Loggerhead turtles were found throughout the study area, but appeared to migrate north to about Massachusetts in summer and south in winter. Leatherbacks appeared to have had a more northerly distribution. CETAP hypothesized a northward migration of both species in the Gulf Stream with a southward return in continental shelf waters nearer to shore. Both species usually were found over the shoreward half of the slope and in depths less than 200 feet. The northwest Atlantic may be important for sea turtle feeding or migrations, but the nesting areas for these species generally are in the South Atlantic and Gulf of Mexico.

This problem may become acute when climatic conditions result in concentration of turtles and fish in the same area at the same time. These conditions apparently are met when temperatures are cool in October but then remain moderate into mid-December and result in a concentration of turtles between Oregon Inlet and Cape Hatteras, North Carolina. In most years sea turtles leave Chesapeake Bay and filter through the area a few weeks before the bluefish fishery becomes concentrated. Efforts are currently under way (by VIMS and the U.S. Fish and Wildlife Service refuges at Back Bay, Virginia, and Pea Island, North Carolina) to more closely monitor these mortalities due to trawls. Fishermen are encouraged to carefully release turtles captured incidentally and to attempt resuscitation of unconscious turtles as recommended in the 1981 *Federal Register* (pages 43976 and 43977).

The only other endangered species occurring in the northwest Atlantic is the shortnose sturgeon (*Acipenser brevirostrum*). The Councils urge fishermen to report any incidental catches of this species to the Regional Administrator, NMFS, One Blackburn Drive, Gloucester, Massachusetts 01930, who will forward the information to persons responsible for the active sturgeon data base.

The range of the species managed under this FMP and the above mentioned marine mammals and endangered species overlap and there always exists a potential for an incidental kill. Except in unique situations, such accidental catches should have a negligible impact on marine mammal or abundances of endangered species, and the Councils do not believe that implementation of this FMP will have any adverse impact upon these populations.

Commercial and recreational fisheries lose thousands of pounds of fishing gear annually. Incidences of entanglement in and ingestion of this gear is common among sea turtles and marine mammals, and may result directly or indirectly in some deaths.

5.1.3.2 Marine sanctuaries

National marine sanctuaries are allowed to be established under the National Marine Sanctuaries Act of 1973. Currently there are 12 designated marine sanctuaries (Figure 32) that creates a system that protects over 14,000 square miles (National Marine Sanctuary Program 1993).

There are four designated national marine sanctuaries in the area covered by the FMP: the *Monitor* National Marine Sanctuary off North Carolina, and the Stellwagen Bank National Marine Sanctuary off Massachusetts, Gray's Reef off Georgia and the Florida Keys National Marine Sanctuary . There is currently one additional proposed sanctuary on the east coast, the Norfolk Canyon.

The *Monitor* National Marine Sanctuary was designated on 30 January 1975, under Title III of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA). Implementing regulations (15 CFR 924) prohibit deploying any equipment in the Sanctuary, fishing activities which involve "anchoring in any manner, stopping, remaining, or drifting without power at any time" (924.3 (a)), and "trawling" (924.3 (h)). The Sanctuary is clearly designated on all National Ocean Service (NOS) charts by the caption "protected area." This minimizes the potential for damage to the Sanctuary by fishing operations. Correspondence for this sanctuary should be addressed to: *Monitor* NMS, NOAA, Building 1519, Fort Ousts, Virginia 23604.

Gray's Reef was designated a National Marine Sanctuary in January 1981. Located 17 miles off the coast of Georgia, Gray's Reef is one of the largest nearshore sandstone reefs in the southeastern United States. The sanctuary encompasses 17 nm^2 of live-bottom habitat. Implementing regulations (15 CFR 922.90) permit recreational fishing and commercial fishing is restricted. Specifically, wire fish traps and bottom tending fishing gears (dredges, trawls etc.) are prohibited. Correspondence for this sanctuary should be addressed to: Gray's Reef Sanctuary Manager, 10 Ocean Science Circle, Savannah, Georgia 31411.

NOAA/NOS issued a proposed rule on 8 February 1991 (56 FR 5282) proposing designation under MPRSA of the Stellwagen Bank National Marine Sanctuary, in federal waters between Cape Cod and Cape May, Massachusetts. On 4 November 1992, the Sanctuary was Congressionally designated. Implementing regulations (15 CFR 940) became effective March 1994. Commercial fishing is not specifically regulated by Stellwagen Bank regulations. The regulations do however call for consultation between federal agencies and the Secretary of Commerce on proposed agency actions in the vicinity of the Sanctuary that "may affect" sanctuary resources. The process for consultation is currently (late 1995) being worked out between the Regional office of NMFS, the Sanctuary, and NEFMC for Amendment 7 to groundfish. Correspondence for this sanctuary should be addressed to: Stellwagen Bank NMS, 14 Union Street, Plymouth, Massachusetts 02360.

The United States Congress passed the Florida Keys National Marine Sanctuary and Protection Act of 1990 designating the Florida Keys a National Marine Sanctuary. The act required NOAA to develop a comprehensive management plan with implementing regulations to govern the overall management of the Sanctuary and to protect and conserve it's resources. The Sanctuary consists of 2,800 nm^2 of coastal and oceanic waters, and the associated submerged lands surrounding the Florida Keys, extending westward to include the Dry Tortugas, but excluding the Dry Tortugas National Park. The sanctuary prohibits the taking of coral or live rock, except as permitted by the NMFS or the state of Florida. The sanctuary contains designated Sanctuary Preservation Areas and Replenishment Reserves where the taking or disturbance of sanctuary resources is prohibited. Fishing is prohibited in these non-consumptive areas. Correspondence for this sanctuary should be addressed to Superintendent, NOAA/Florida Keys National Marine Sanctuary, P.O. Box 500368, Marathon, Florida 33050.

Details on sanctuary regulations may be obtained from the Chief, Sanctuaries and Reserves Division (SSMC4) Office of Ocean and Coastal Resource Management, NOAA, 1305 East-West Highway, Silver Spring, Maryland 20910.

5.1.3.3 Indian treaty fishing rights

No Indian treaty fishing rights are known to exist in the fishery.

5.1.3.4 Oil, gas, mineral, and deep water port development

While Outer Continental Shelf (OCS) development plans may involve areas overlapping those contemplated for offshore fishery management, no major conflicts have been identified to date. The Councils, through involvement in the Intergovernmental Planning Program of the MMS, monitor OCS activities and have opportunity to comment and to advise MMS of the Councils' activities. Certainly, the potential for conflict exists if communication between interests is not maintained or appreciation of each other's efforts is lacking. Potential conflicts include, from a fishery management position: (1) exclusion areas, (2) adverse impacts to sensitive biologically important areas, (3) oil contamination, (4) substrate hazards to conventional fishing gear, and (5) competition for crews and harbor space. The Councils are unaware of pending deep water port plans which would directly impact offshore fishery management goals in the areas under consideration, and are unaware of potential effects of offshore FMPs upon future development of deep water port facilities.

5.1.3.5 Paper work reduction act of 1995

The Paperwork Reduction Act concerns the collection of information. The intent of the Act is to minimize the federal paperwork burden for individuals, small business, state and local governments, and other persons as well as to maximize the usefulness of information collected by the federal government.

The Council proposes, through this Amendment, to establish the implementation of Operator Permits. The total public reporting burdens for the time for reviewing instructions, searching existing data, collection of information and maintaining the data needed, reviewing the collection of information, and reporting requirements are estimated to be minimal since there are so few surfclam and ocean quahog fishermen that do not already have other Operator Permits for other fisheries. Section 4 of this Amendment details the minimal associated costs for the fishermen and government. There is no need to actually go through PRA analyzes since NERO of NMFS has a blanket coverage for Operator Permits under the PRA.

5.1.3.6 Impacts of the plan relative to federalism

The Amendment does not contain policies with federalism implications sufficient to warrant preparation of a federalism assessment under Executive Order 12612.

5.1.4 State, Local, and Other Applicable Law and Policies

5.1.4.1 State management activities

No reason to change this section at this time.

5.1.4.2 Impact of federal regulations on state management activities

No reason to change this section at this time.

5.1.4.3 Coastal zone management program consistency

The CZM Act of 1972, as amended, provides measures for ensuring stability of productive fishery habitat while striving to balance development pressures with social, economic, cultural, and other impacts on the coastal zone. It is recognized that responsible management of both coastal zones and fish stocks must involve mutually supportive goals.

The Council must determine whether the Amendment will affect a state's coastal zone. If it will, the FMP must be evaluated relative to the state's approved CZM program to determine whether it is consistent to the maximum extent practicable. The states have 45 days in which to agree or disagree with the Councils' evaluation. If a state fails to respond within 45 days, the state's agreement may be presumed. If a state disagrees, the issue may be resolved through negotiation or, if that fails, by the Secretary.

The FMP was reviewed relative to CZM programs of Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina. Letters will be sent to all of the states listed along with a hearing draft of the Amendment. The letters to all of the states will state that the Council concluded that the Amendment would not affect the state's coastal zone and was consistent to the maximum extent practicable with the state's CZM program as understood by the Council. It should be reemphasized that management of these two species occurs in the EEZ only, except for the small zone off of the coast of Maine.

6.0 COUNCIL REVIEW AND MONITORING OF THE FMP

No reason to change this section at this time.

7.0 LIST OF PREPARERS

This Amendment was prepared by the following members of the MAFMC staff - Dr. Thomas B. Hoff, Clayton E. Heaton, Dr. Christopher M. Moore, Valerie M. Whalon, and Meggan Kane. In addition to the NEFSC scientific personnel (Drs. Jim Wienberg, Paul Rago, and Steve Murawski) who have worked extensively on the two new stock assessments (NEFSC 1998a and 1998b), Dr. Jeffrey Cross at NMFS Sandy Hook and Timothy Goodger of NMFS Oxford, contributed greatly to the EFH information.

8.0 AGENCIES AND ORGANIZATIONS

In preparing the Amendment, the Council consulted with the NMFS, the New England Fishery Management Council, the Fish and Wildlife Service, the Department of State, and the States of New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina through their membership on the Council and the following committees - MAFMC Surfclam and Ocean Quahog Committee, MAFMC Statistical and Science Committee, Mid-Atlantic EFH Technical Committee, Northeast Region Steering Committee, MAFMC Habitat Committee, and MAFMC Habitat Advisory Panel. In addition to the states that are members of this Council, Maine, New Hampshire, Massachusetts, Rhode Island, and Connecticut were all consulted through the Coastal Zone Management Program consistency process.

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Table 1. Estimates of surfclam stock size, catch, fishing mortality rate (F), and annual biomass production by region. Values are from NEFSC (1998).

Region	Mean Stock Biomass Estimate from 1997 (million lbs)	1996 Catch (thousand lbs)	F	Annual Production (million lbs)
GBK	645.7	0	0.000	74.6
SNE	172.9	180.7	0.001	0.5
LI	40.4	57.3	0.002	1.2
NNJ	899.7	35,443.3	0.041	44.3
SNJ	79.4	2,934.3	0.039	3.3
DMV	626.9	4,931.7	0.008	32.7
SVA/NC	22.6	0	0.000	8.8
ALL	2,490.6	43,547.5	0.018	164.5

Source: Weinberg pers. comm.

Table 2. Forecast table for ocean quahogs from supply-year model (starting value for 1997 exploitable biomass: 2.11 billion lbs meats).

Supply-year policy	Year	Exploitable biomass (billion lbs)	% of 1997 value	Total biomass (billion lbs)	Catch (million lbs)	Annual exploitation rate (%)	
						Exploited areas	All areas
30	1999	2.03	95.9	2.93	79.9	3.9	2.7
	2000	1.95	92.1	2.85	77.6	4.0	2.7
54	1999	2.03	95.9	2.93	[1] 50.0	2.5	1.7
	2000	1.98	93.5	2.88	49.3	2.5	1.7
63	1999	2.03	95.9	2.93	[2] 45.0	2.2	1.5
	2000	1.98	93.7	2.88	44.5	2.2	1.5
76	1999	2.03	95.9	2.93	[3] 40.0	2.0	1.4
	2000	1.99	94.0	2.89	39.6	2.0	1.4

Model results are based on the following inputs: the exploited region is SNE-DMV; stock biomass includes all sizes, assuming a dredge efficiency of 0.43 and unrevised length/weight equations; GBK is unexploited and is 30% of initial stock biomass; annual recruitment by pre-recruits is 23.8 million lbs/yr in the exploited region and 10.2 million lbs/yr in the unexploited region, M = 0.02; instantaneous growth (g) rate of full recruits is 0.0076 per year; the 1998 catch is assumed to be 40.0 million lbs, the EEZ quota. [1]5 million bushels. [2]4.5 million bushels. [3]4 million bushels.
Source: NEFSC 1998b.

Table 3. Forecast table from production model, short-term 1-year projection, (weights in million lbs): ocean quahogs (all sizes).

Region	Size frequency	Annual production of biomass	Direct + indirect[1] annual landings	Current[2] biomass	Projected biomass	% change in biomass
GBK	Original	16.7	0	114.9	1,165.6	1.45
	[3]Augmented	22.6			1,171.6	1.97
SNE	Original	0.3	16.3	713.7	693.3	-2.86
	Augmented	3.5			696.5	-2.41
LI	Original	-3.6	11.9	1,074.9	1,059.4	-1.44
	Augmented	-2.8			1,060.2	-1.37
NJ	Original	-5.3	9.8	600.6	585.5	-2.52
	Augmented	-5.0			585.8	-2.46
DMV	Original	-1.0	2.4	131.9	128.4	-2.60
	Augmented	-0.8			128.6	-2.47
SVA	Original	0	0	0.1	0.1	-
	Augmented	0			0.1	-
Total[4] stock	Original	7.1	44.9	3,670.1	3,632.3	-1.03
	Augmented	17.6			3,642.8	-0.74

[1]Indirect landings are assumed to be 5% of the reported landings from 1997. [2]Biomass estimates include all sizes, are based on 1-mm size intervals and revised length/weight equations from 1997, and assume dredge efficiency = 0.43. [3]"Augmented" to account for low selectivity of small individuals. [4]Includes GBK.
Source: NEFSC 1998b.

Table 4. Summary of life history and habitat parameters of the Atlantic surfclam. Information is presented for each life stage (eggs, larvae, juveniles/adults, and spawning adults).

Life Stage	Size and Growth	Distribution / Density	Substrate	Temperature	Salinity
EGGS[1]	Unfertilized eggs are 56 μm in diameter.			6 - 24°C optimal for fertilization.	Sperm and eggs can withstand salinities as low as 40% diluted seawater for 2-3 h. Hypo- or hypertonicity may cause parthenogenesis
LARVAE[2]	At 22°C: 28 hr to straight hinge veligers. At 21.7°C: trochophore larvae 9hrs post-fertilization, veligers 19-20hrs, pediveligers at 18d. At 14°C: 40 hr to trochophore, 72 hr to straight hingeveligers. Metamorphosis: 35d at 14°C, 19 d at 22°C. Most larvae metamorphose at 230-250 μm, although one study reports 303 μm.	One study in Massachusetts found the highest concentration of larvae (823 larvae/m^3) at 30 m in early October. In NJ, high concentrations of larvae occur from May-June and Sept-Oct; minor peaks sometimes occur in July. spring larvae were derived from inshore clams, while fall larvae were derived from offshore clams.		Larvae tolerate 14-30°C; optimum 22°C, mortality >30°C. Larvae reared at lower temps were smaller than those at warmer temps. In New England, high larval concentrations are associated with 14-18°C water.	Larvae in the lab can survive and grow at 16 ppt; with acclimation as low as 8 ppt. Larvae starting at 30 ppt crossed a salinity gradient of 5 ppt and 10 ppt, but not 15 ppt. Upward swimming rate increased with salinity, larvae stayed in high salinity.
JUVENILES / ADULTS[3]	Growth rates are similar for the first 3-5 years of life, then offshore clams grow more rapidly than inshore clams. High population density reduces growth rate and maximun lengths of 226 mm and 37 yrs of age.	Range from the Gulf of Maine south to Cape Hatteras, NC. Oceanic, most turbulent areas beyond breaker zone, from 8-66m. Distribution of beds ranges from even aggregations to localized or patchy dense beds.	Adults burrow in medium to coarse sand and gravel substrates, also found in silty to fine sand, do not borrow in mud. Substrate type does not affect growth rate.	37°C is lethal in the lab. Clams survive temps as low as 2°C in the field; clams are more active >15°C. Burrowing is fastest at 16-26°C; inhibited ≥30°C. Growth rate is positively correlated with temperature, growth most rapid in spring/early summer.	Adults in lab tolerated 14-52 ppt. Surfclams at 28 ppts in the field survived in the lab at 12.5 ppt for several days, suggesting that a variable other than salinity controls distribution.
SPAWNING ADULTS[4]				Spawning occurs from 19.5-30°C; detrimental > 30°C. Laboratory: burrowing increased up to 20°C, but decreased >20°C. Temperature important for initiation and timing of both gonadal development and spawning. Off NJ, spawning heaviest in summer/fall when temperatures are at their highest; may be a minor Oct spawning, brought about by breakdown of thermocline. Delayed spawning and single annual cycle may be related to cold temps. Abrupt temp. changes not a clear cause of spawning in nature.	

[1] Allen (1953), Schechter (1956), Yancey and Welch (1968), Castagna and Chanley (1973), Wright *et al.* (1983), Roosenberg *et al.* (1984), Clotteau and Dubé (1993)
[2] Loosanoff and Davis (1963), Yancey and Welch (1968), Ropes (1980), Tarnowski (1982), Fay *et al.* (1983), Wright *et al.* (1983), Roosenberg *et al.* (1984), Mann (1985), Mann *et al.* (1991), Ma (1997)
[3] Henderson (1929), Clarke (1954), Yancey and Welch (1968), Merrill and Ropes (1969), Ogren and Chess (1969), Ropes and Merrill (1970), Castagna and Chanley (1973), Flowers (1973), Franz (1976), Savage (1976), Loesch and Ropes (1977), Ropes and Ward (1977), Goldberg (1978), Jones *et al.* (1978, 1983), Ropes (1978, 1980), Boesch (1979), Prior *et al.* (1979), Ambrose *et al.* (1980), Garlo (1980), Jones (1980, 1981a), Meyer *et al.* (1981), Fay *et al.* (1983), Wagner (1984), MacKenzie *et al.* (1985), Fogarty and Murawski (1986), Howe *et al.* (1988), Murawski and Serchuk (1989), Goldberg and Walker (1990), Sephton and Bryan (1990), Walker and Heffernan (1990, 1994), Cerrato and Keith (1992), Dames and Moore (1993), Weinberg (1995, 1998), Weinberg and Helser (1996), Chintala (1997)
[4] Loosanoff and Davis (1963), Ropes (1968a,b, 1980, 1982), Jones (1981b), Fay *et al.* (1983), Sephton (1987), Kanti *et al.* (1993), Chintala and Grassle (1995)

Table 4 (continued). Summary of the life history and habitat parameters of the Atlantic surfclam. Information is presented for each life stage (eggs, larvae, juveniles/adults, and spawning adults).

Life Stage	Dissolved Oxygen	Currents	Prey	Predators	Spawning Period	Notes
EGGS[1]					*spawning adults section*	Fertilization occurs in water column above spawning beds; pH 7.8-10 optimal for fertilization.
LARVAE[2]		Larval settlement coincides with relaxation of upwelling events. Dispersal via water currents, swimming and crawling occur during larval stages. Convergence of tidal and longshore currents may trap larvae off western Long Island.				
JUVENILES / ADULTS[3]	Hypoxia may be lethal, or lower growth rate and maximum size in the field. In the lab, burrowing time was slower at 1.45 mg/l than at higher D.O. levels. Clams died after 5 d at a D.O. of 0.9 mg/l. anoxic event in 1976 off NJ and Long Island killed 62% of NJ surfclam resource; lower lethal limit of 2 ppm D.O. assumed.	Currents important in determining eventual patterns of distribution and settlement of developing juveniles. Oceanic storms and currents may displace adults considerable distance from burrows; survivors reburrow at new site.	Planktivorous siphon feeders. Food varies with season, geographic location and depth of bed; feed primarily on phytoplankton, especially diatoms and ciliates. Retain particles ≥ 4 μm diameter.	Primarily moon snails, also sea stars, horseshoe crabs, lady crabs, Jonah crabs, sea gulls, & shrimp. Predation rate of moon snails lowered by low temps. and salinities, ceased feeding at <2 and 5°C respectively, and <10 and 6 ppt salinity respectively. Haddock and cod prey on injured clams after storms.		Metamorphosis to juveniles and settlement to substrate ranges from 18-35d (varies with temp.). The age of maturity ranges from 3 months to 4 yrs post-settlement. Without examining the gonads of small clams, one can't assume level of maturity. Longevity up to 25 yrs; largest individual recorded 226 mm.
SPAWNING ADULTS[4]					Surfclams can reach sexual maturity and spawn as early as 3 months post settlement. Off NJ: major spawning early July-mid Aug; in some years second major spawning occurs mid-Oct. Spawning is earlier in more southern areas.	Rate of temperature change may be a more important stimulus for spawning than ambient temperature.

Source: Weissberger *et al.* 1998a.

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

[1] Allen (1953), Fay *et al.* (1983), Clotteau and Dubé (1993)

[2] Ropes (1980), Mann (1985), Ma (1997)

[3] Leidy (1878), Ropes and Merrill (1966, 1973), Yancey and Welch (1968), Ogren and Chess (1969), Jacobson (1972), Savage (1976), Franz (1977), Goldberg (1978), Garlo *et al.* (1979), Prior *et al.* (1979), Ropes *et al.* (1979), Thurberg and Goodlett (1979), Garlo (1980, 1982), Ropes (1980), Fay *et al.* (1983), Botton and Haskin (1984), Robinson *et al.* (1984), MacKenzie *et al.* (1985), Howe *et al.* (1988), Riisgård (1988), Walker and Heffernan (1990), Stehlik (1993), Viscido (1994), Chintala and Grassle (1995), Weinberg and Helser (1996), Dietl and Alexander (1997)

[4] Allen (1951), Loosanoff and Davis (1963), Ropes (1968a,b, 1979, 1980, 1982), Yancey and Welch (1968), Jones (1981b), Meyer *et al.* (1981), Tarnowski (1982), Fay *et al.* (1983), Mann (1985), Sephton (1987), Kanti *et al.* (1993), Chintala and Grassle (1995)

Table 5. Summary of the life history and habitat parameters of the ocean quahog. Information is presented for each life stage (larvae, juveniles, adults, and spawning adults).

Life Stage	Size and Growth	Habitat	Substrate	Temperature	Salinity
LARVAE[1]	Larval period (hatching to settlement) is 32 days long at 13°C and 55 days at 8.5-10°C. Size at metamorphosis ranges from 175-240 μm.	Larval settlement believed to occur throughout adult distribution range. Larvae present in New England waters in May and July-Nov.		Larvae abundant at temperatures of 14-18°C.	Found at oceanic salinities.
JUVENILES[2]	Metamorphosis occurs at 175-240 μm. Growth is relatively fast during juvenile period: in the field, individuals 9-20 mm long grew 9.5 mm/year; in the lab, individuals 2-5 years old grew 18 mm/year.		Medium to fine grain sand, sandy mud, silty sand.	Capable of surviving laboratory experiments at temperatures of 1-20°C.	Found at oceanic salinities.
ADULTS[3]	One of the longest-lived bivalves. Maximum age of 225 years. When >50 mm, growth very slow (<1 mm/year), or not at all. Growth is negatively correlated with density.	Although capable of surviving in shallower sites, most commercial concentrations found at 25-61 m depth. Occur shallower in Gulf of Maine, and deeper south of Cape Cod.	Medium to fine grain sand, sandy mud, silty sand.	Restricted to cooler waters where temps rarely exceed 20°C. Optimal temperature range: 6-16°C. Inshore limit appears to be the 16°C bottom isotherm in summer.	Found at oceanic salinities, but kept successfully in the lab at salinities as low as 22 ppt.
SPAWNING ADULTS[4]	Earliest age of maturity is 7 years, but mean is 13.1 years and 49.9 mm for males, and 12.5 years and 49.2 mm for females.		Medium to fine grain sand, sandy mud, silty sand	Spawning may occur when a critical temperature is reached (13.5°C), but other stimuli (DO, pH, food availability) may also be important. Lab studies have shown no effect of temperature on spawning.	Role of salinity as a stimulus for spawning unclear. Changes in salinity did not induce spawning in the lab.

[1] Landers (1972, 1976), Lutz *et al.* (1981, 1982), Mann (1985, 1989), Mann and Wolf (1983)

[2] Murawski *et al.* (1980, 1982), Fogarty (1981), Lutz *et al.* (1982, 1989), Ropes *et al.* (1984), Kraus *et al.* (1989, 1991, 1992), Kennish *et al.* (1994), Witbaard *et al.* (1997)

[3] Merrill and Ropes (1969), Merrill *et al.* (1969), Medcof and Caddy (1971), Golikov and Scarlato (1973), Ropes (1978), Jones (1980), Murawski *et al.* (1980, 1982), Thompson *et al.* (1980a), Fogarty (1981), Ropes and Pyoas (1982), Serchuk *et al.* (1982), Turekian *et al.* (1982), Ropes and Murawski (1983), Ropes *et al.* (1984a,b), Beal and Kraus (1989), Fritz (1989, 1991), Kennish *et al.* (1994), Weidman and Jones (1994), Kennish and Lutz (1995)

[4] Loosanoff (1953), Medcof and Caddy (1971), Landers (1976), Fogarty (1981), Jones (1981), Mann (1982), Beal and Kraus (1989), Rowell *et al.* (1990)

Table 5 (continued). Summary of the life history and habitat parameters of the ocean quahog. Information is presented for each life stage (larvae, juveniles, adults, and spawning adults).

Life Stage	Currents	Prey	Predators	Notes
LARVAE[1]	Eggs and larvae are planktonic, drifting with currents until larvae metamorphose and settle to bottom.	Unicellular algae		Three larval stages: trochophore, veliger and pediveliger.
JUVENILES[2]		Unicellular algae	Predators include rock crabs, sea stars, boring snails and teleost fish (cod, haddock, sculpin, and ocean pout).	Age at first maturity varies from 6 to >14 years, and may depend on growth rate and locality.
ADULTS[3]		Suspension feeders on phytoplankton. Pump water using their siphons.	Predators include rock crabs, sea stars, boring snails and teleost fish (cod and haddock).	Occur in dense beds over level bottoms. Capable of surviving low oxygen levels; can burrow into the substrate and respire anaerobically for up to a week. Critical O_2 tension 5-7 kPa.
SPAWNING ADULTS[4]		N/A	N/A	Extended spawning period, from May through December, with several peaks during this time. Multiple spawnings likely.

Source: Weissberger *et al.* 1998b.

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

[1] Mann (1985)
[2] Clarke (1954), Thompson *et al.* (1980b), Lutz *et al.* (1982), Kraus *et al.* (1989, 1991, 1992), Rowell *et al.* (1990), Kennish *et al.* (1994), Witbaard (1997)
[3] Clarke (1954), Winter (1969, 1970), Medcof and Caddy (1971), Ropes *et al.* (1979), Stehlik (1993)
[4] Loosanoff (1953), Landers (1976), Jones (1981), Mann (1982, 1985), Rowell *et al.* (1990), Fritz (1991)

Table 6. Approximate area (percent and number of 10 minute squares) for the surfclam catch and area EFH alternatives, for surfclam pre-recruits and recruits caught in the NEFSC dredge survey. The logged catch alternative was not presented because the percent area and number of squares consistently fall between the catch and area alternatives. The preferred alternative is 90% of the area.

Surfclam pre-recruits

% Area	% Catch Index	Number of 10" Quadrangles
0	0	0
5	50	12
12	75	29
31	90	75
50	92	120
75	95	180
90	98	216
100	100	240

Surfclam recruits

% Area	% Catch Index	Number of 10" Squares
0	0	0
13	50	2
27	75	50
17	90	75
50	93	94
75	96	141
90	99	169
100	100	188

Table 7. Approximate area (percent and number of 10 minute squares) for the ocean quahog catch and area EFH alternatives, for ocean quahog pre-recruits and recruits caught in the NEFSC dredge survey. The logged catch alternative was not presented because the percent area and number of squares consistently fall between the catch and area alternatives. The preferred alternative is 90% of the area.

Ocean quahog pre-recruits

% Area	% Catch Index	Number of 10" Squares
0	0	0
5	50	10
13	75	25
26	90	49
50	93	95
75	96	141
90	98	169
100	100	188

Ocean quahog recruits

% Area	% Catch Index	Number of 10" Squares
0	0	0
18	50	38
30	75	65
48	90	103
58	92	108
75	95	161
90	98	194
100	100	215

Table 8. Comparisons of intensity and severity of various sources of physical disturbance to the seafloor (based on Hall 1994, Watling and Norse MS1997). Intensity is a measure of the force of physical disturbance and severity is the impact on the benthic community.

Source	Intensity	Severity
ABIOTIC		
Waves	Low during long temporal periods but high during storm events (to 70-80 m depth)	Low over long temporal periods since taxa adapted to these events but high locally depending on storm behavior
Currents	Low since bed shear normally lower than critical velocities for large volume and rapid sediment movement	Low since benthic stages rarely lost due to currents
Iceberg Scour	High locally since scouring results in significant sediment movement but low regionally	High locally due to high mortality of animals but low regionally
BIOTIC		
Bioturbation	Low since sediment movement rates are small	Low since infauna have time to repair tubes and burrows
Predation	Low on a regional scale but high locally due to patchy foraging	Low on a regional scale but high locally due to small spatial scales of high mortality
HUMAN		
Dredging	Low on a regional scale but high locally due to large volumes of sediment removal	Low on a regional scale but high locally due to high mortality of animals
Land Alteration (Causing silt laden runoff)	Low since sediment laden runoff per se does not exert a strong physical force	Low on a regional scale but high locally where siltation over coarser sediments causes shifts in associated communities
Fishing	High due to region wide fishing effort	High due to region wide disturbance of most types of habitat

Source: Auster and Langton 1998.

Table 9. Studies of the impacts of fishing gear on the structural components of fish habitat.

Habitat	Gear Type	Location	Results	Reference(s)
Eelgrass	Scallop dredge	North Carolina	Comparison of reference quadrats with treatments of 15 and 30 dredgings in hard sand and soft mud substrates within eelgrass meadows. Eelgrass biomass was significantly greater in hard sand than soft mud sites. Increased dredging resulted in significant reductions in eelgrass biomass and number of shoots.	Fonesca et al. (1984)
Eelgrass and shoalgrass	Clam rake and "clam kicking"	North Carolina	Comparison of effect of two fishing methods. Raking and "light" clam kicking treatments, biomass of seagrass was reduced approximately 25% below reference sites but recovered within one year. In "intense" clam kicking treatments, biomass of seagrass declined approximately 65% below reference sites. Recovery did not begin until more than 2 years after impact and biomass was still 35% below the level predicted from controls to show no effect.	Peterson et al. (1987)
Eelgrass and shoalgrass	Clam rakes (pea digger and bull rake)	North Carolina	Compared impacts of two clam rake types on removal of seagrass biomass. The bull rake removed 89% of shoots and 83% of roots and rhizomes in a completely raked 1 m2 area. The pea digger removed 55% of shoots and 37% of roots and rhizomes.	Peterson et al. (1983)
Seagrass	Trawl	western Mediter-ranean	Noted loss of *Posidonia* meadows due to trawling; 45% of study area. Monitored recovery of the meadows after installing artificial reefs to stop trawling. After 3 years plant density has increased by a factor of 6.	Guillen et al. (1994)
Sponge-coral hard-bottom	Roller-rigged trawl	off Georgia coast	Assessed effect of single tow. Damage to all species of sponge and coral observed; 31.7% of sponges, 30.4% of stony corals, and 3.9% of octocorals. Only density of barrel sponges (*Cliona* spp.) significantly reduced. Percent of stony coral damage high because of low abundance. Damage to other sponges, octocorals, and hard corals varied but changes in density not significantly different. No significant differences between trawled and reference sites after 12 months.	Van Dolah et al. (1987)
Sponge-coral hard-bottom	roller-frame shrimp trawl	Biscayne Bay, Florida	Damage to approximately 50% of sponges, 80% of stony corals, and 38% of soft corals.	Tilmant (1979) (cited in Van Dolah et al. 1987)

Source: Auster and Langton 1998.

Table 9 (continued). **Studies of the impacts of fishing gear on the structural components of fish habitat.**

Habitat	Gear Type	Location	Results	Reference(s)
Various tropical emergent benthos	Trawl	North West Shelf, Australia	Catch rates of all fish and large and small benthos show that in closed areas fish and small benthos abundance increased over 5 years while large benthos (>25 cm) stayed the same or increased slightly. In trawled areas all groups of animals declined. Found that settlement rate and growth to 25 cm was on the order of 15 years for the benthos.	Sainsbury et al. (In press)
Gravel pavement	Scallop dredge	Georges Bank	Assessed cumulative impact of fishing. Undredged sites had significantly higher percent cover of the tube-dwelling polychaete *Filograna implexa* and other emergent epifauna than dredged sites. Undredged sites had higher numbers of organisms, biomass, species richness, and species diversity than dredged sites. Undredged sites were characterized by bushy epifauna (bryozoans, hydroids, worm tubes) while dredged sites were dominated by hard-shelled molluscs, crabs, and echinoderms.	Collie et al. (1996, 1997)
Gravel-boulder	Assumed roller-rigged trawl	Gulf of Maine	Comparison of site surveyed in 1987 and revisited in 1993. Initially mud draped boulders and high density patches of diverse sponge fauna. In 1993, evidence of moved boulders, reduced densities of epifauna and extreme truncation of high density patches.	Auster et al. (1996)
Cobble-shell	Assumed trawl and scallop dredge	Gulf of Maine	Comparison of fished site and adjacent closed area. Statistically significant reduction in cover provided by emergent epifauna (e.g., hydroids, bryozoans, sponges, serpulid worms) and sea cucumbers.	Auster et al. (1996)
Gravel	Beam trawl	Irish Sea	An experimental area was towed 10 times. Density of epifauna (e.g., hydroids; soft corals, *Alcyonium digitatum*) was decreased approximately 50%.	Kaiser and Spencer (1996a)
Boulder-Gravel	Roller-rigged trawl	Gulf of Alaska	Comparisons of single tow trawled lane with adjacent reference lane. Significant reductions in density of structural components of habitat (two types of large sponges and anthozoans). No significant differences in densities of a small sponge and mobile invertebrate fauna. 20.1% boulders moved or dragged. 25% of ophiuroids (*Amphiophiura ponderosa*) in trawled lanes were crushed or damaged compared to 2% in reference lanes.	Freese et al. (In prep.)
Gravel over sand	Scallop dredge	Gulf of St. Lawrence	Assessed effects of single tows. Suspended fine sediments and buried gravel below the sediment-water interface. Overturns boulders.	Caddy (1973)

Source: Auster and Langton 1998.

Table 9 (continued). Studies of the impacts of fishing gear on the structural components of fish habitat.

Habitat	Gear Type	Location	Results	Reference(s)
Bryozoan beds (on sand and cobble)	Otter trawl and roller-rigged trawl	New Zealand	Qualitative comparison of closed and open areas. Two bryozoans produce "coral-like" forms and provide shelter for fishes and their prey. Comparisons of fished site with reference sites and prior observations from fishers show reduced density and size of colonies.	Bradstock and Gordon (1983)
Mussel bed	Otter trawl	Strangford Lough, Northern Ireland	Comparison of characteristics of trawled and untrawled *Modiolus modiolus* beds as pre and post impacts of a trawl. Trawled areas, confirmed with sidescan sonar, showed mussel beds disconnected with reductions in attached epibenthos. The most impacted sites were characterized by few or no intact clumps, mostly shell debris, and sparse epifauna. Trawling resulted in a gradient of complexity with flattened regions at the extreme. Immigration of *Nephrops* into areas previously dominated by *Modiolus* may result in burial of new recruits due to burrowing activities; precluding a return to a functional mussel bed habitat.	Magorrian (1995)
Sand-mud	Trawl and scallop dredge	Hauraki Gulf, New Zealand	Comparisons of 18 sites along a gradient of fishing effort (i.e., heavily fished sites through unfished reference sites). A gradient of increasing large epifaunal cover correlated with decreasing fishing effort.	Thrush et al. (In press)
Soft sediment	Scallop dredge	Port Phillip Bay, Australia	Compared reference and experimentally towed sites in BACI designed experiment. Bedforms consisted of cone shaped callianasid mounds and depressions prior to impact. Depressions often contained detached seagrasses and macroalgae. Only dredged plot changed after dredging. Eight days after dredging the area was flattened; mounds were removed and depressions filled. Most callianasids survived and density did not change in 3 mo following dredging. One month post impact, seafloor remained flat and dredge tracks distinguishable. Six months post impact mounds and depressions were present but only at 11 months did the impacted plot return to control plot conditions.	Currie and Parry (1996)
Sand	Beam trawl	North Sea	Observations of effects of gear. As pertains to habitat, trawl removed high numbers of the hydroid *Tubularia*.	DeGroot (1984)

Source: Auster and Langton 1998.

Table 9 (continued). Studies of the impacts of fishing gear on the structural components of fish habitat.

Habitat	Gear Type	Location	Results	Reference(s)
Gravel-sand-mud	Trawl	Monterey Bay	Comparison of heavily trawled (HT) and lightly trawled (LT) sites. The seafloor in the HT area had significantly higher densities of trawl tracks while the LT area had significantly greater densities of rocks >5 cm and mounds. The HT area had shell debris on the surface while the LT area had a cover of flocculent material. Emergent epifauna density was significantly higher for all taxa (anenomes, sea pens, sea whips) in the LT area.	Engel and Kvitek (MS1997)
Sand	Otter trawl	North Sea	Observations of direct effects of gear. Well buried boulders removed and displaced from sediment. Trawl doors smoothed sand waves. Penetrated seabed 0-40 mm (sand and mud).	Bridger (1970, 1972)
Sand-shell	Assumed trawl and scallop dredge	Gulf of Maine	Comparison of fished site and adjacent closed area. Statically significant reduction of habitat complexity based on reduced cover provided by biogenic depressions and sea cucumbers. Observations at another site showed multiple scallop dredge paths resulting in smoothed bedforms. Scallop dredge paths removed cover provided by hydrozoans which reduced local densities of associated shrimp species. Evidence of shell aggregates dispersed by scallop dredge.	Auster et al. (1996)
Sand-silt to mud	Otter trawl with chain sweep and roller gear	Long Island Sound	Diver observations showed doors produced continuous furrows. Chain gear in wing areas disrupted amphipod tube mats and bounced on bottom around mouth of net, leaving small scoured depressions. In areas with drifting macroalgae, the algae draped over grounder of net during tows and buffered effects on the seafloor. Roller gear also created scoured depressions. Spacers between discs lessened impacts.	Smith et al. 1985

Source: Auster and Langton 1998.

Table 10. Studies of short-term impacts of fishing on benthic communities.

Taxa	Gear and Sediment Type	Region	Results	Reference(s)
Infauna	beam trawl; megaripples and flat substrate	Irish Sea, U.K.	Assessed at the immediate effects of beam trawling and found a reduction in diversity and abundance of some taxa in the more stable sediments of the northeast sector of their experimental site but could not find similar effects in the more mobile sediments. Out of the top 20 species 19 had lower abundance levels at the fished site and nine showed a statistically significant decrease. Coefficient of variation for numbers and abundance was higher in the fished area of the NW sector supporting the hypothesis that heterogeneity increases with physical disturbance. Measured a 58% decrease in mean abundance and a 50% reduction in the mean number of species per sample in the sector resulting from removal of the most common species. Less dramatic change in the sector where sediments are more mobile.	Kaiser and Spencer (1996a)
Starfish	beam trawl; coarse sand, gravel and shell, muddy sand, mud	Irish Sea, U.K.	Evaluated damage to starfish at three sites in the Irish sea that experienced different degrees of trawling intensity. Used ICES data to select sites and used side scan to confirm trawling intensity. Found a significant correlation between starfish damage (arm regeneration) and trawling intensity.	Kaiser (1996)
Horse mussels	otter trawl; horse mussel beds,	Strangford Lough; N. Ireland	Used video/rov, side scan and benthic grabs to characterize the effect of otter trawling and scallop dredging on the benthic community. There was special concern over the impact on *Modiolus* beds in the Lough. Plotted the known fishing areas and graded impacts based on a subjective 6 point scale; found significant trawl impacts. Side scan supported video observations and showed areas of greatest impact. Found that in otter trawl areas that the otter boards did the most damage. Side scan suggested that sediment characteristics had changed in heavily trawled areas.	Industrial Science Division. (1990)
Benthic fauna	beam trawl; mobile megaripples structure and stable uniform sediment	Irish Sea, U.K.	Sampled trawled areas 24 hours after trawling and 6 months later. On stable sediment found significant difference immediately after trawling. Reduction in polychaetes but increase in hermit crabs. After six months there was no detectable impact. On megaripples substrate no significant differences were observed immediately after trawling or 6 months later.	Kaiser et al MS 1997

Source: Auster and Langton 1998.

Table 10 (continued). Studies of short-term impacts of fishing on benthic communities.

Taxa	Gear and Sediment Type	Region	Results	Reference(s)
Bivalves, sea scallop, surf clams, ocean quahog	scallop dredge, hydraulic clam dredge; various substrate types	Mid-Atlantic Bight, USA	Submersible study of bivalve harvest operations. Scallops harvested on soft sediment (sand or mud) had low dredge induced mortality for uncaught animals (<5%). Culling mortality (discarded bycatch) was low, approx. 10%. Over 90% of the quahogs that were discarded reburrowed and survived whereas 50% of the surf clams died. Predators crabs, starfish, fish and skates, moved in on the quahogs and clams in the predator density 10 items control area levels within 8 hours post dredging. Noted numerous "minute" predators feeding in trawl tracks. Non-harvested animals, sand dollars, crustaceans and worms significantly disrupted but sand dollars suffered little apparent mortality.	Murawski and Serchuck (1989)
Ocean quahog	hydraulic clam dredge;	Long Island, N.Y., USA	Evaluated clam dredge efficiency over a transect and changed up to 24 hours later. After dredge fills it creates a "windrow of clams". Dredge penetrates up to 30 cm and pushes sediment into track shoulders. After 24 hours track looks like a shallow depression. Clams can be cut or crushed by dredge with mortality ranging from 7 to 92 %, being dependent on size and location along dredge path. Smaller clams survive better and are capable of reburrowing in a few minutes. Predators, crabs, starfish and snails, move in rapidly and depart within 24 hours.	Meyer et al. (1981)
Macro-benthos	scallop dredge; coarse sand	Mercury Bay, New Zealand	Benthic community composed of small short-lived animals at two experimental and adjacent control sites. Sampling before and after dredging and three months later. Dredging caused an immediate decrease in density of common macrofauna. Three months later some populations had not recovered. Immediate post-trawling snails, hermit crabs and starfish were feeding on damaged and exposed animals	Thrush et al. (1995)
Scallops and associated fauna	scallop dredge; "soft sediment"	Port Phillip Bay, Australia	Sampled twice before dredging and three times afterwards, up to 88 days later. The mean difference in species number increased from 3 to 18 after trawling. The total number of individuals increased over the sampling time on both experimental and control primarily as a result of amphipod recruitment, but the number of individuals at the dredged sites were always lower than the control. Dissimilarity increased significantly, as a result of dredging, because of a decrease in species numbers and abundance.	Currie and Parry (1994)

Source: Auster and Langton 1998.

Table 10 (continued). Studies of short-term impacts of fishing on benthic communities.

Taxa	Gear and Sediment Type	Region	Results	Reference(s)
Sea Scallops and associated fauna	otter trawl and scallop dredge; gravel and sand	Gulf of St. Lawrence, Canada	Observed physical change to sea floor from otter doors and scallop dredge and lethal and nonlethal damage to the scallops. Noted an increase in the most active predators within the trawl tracks compared to outside; winter flounder, sculpins and rock crabs. No increase in starfish or other sedentary forms within in an hour of dredging.	Caddy (1973)
Macrofauna	beam trawl; hard-sandy substrate	North Sea, coast of Holland	Sampling before and after beam trawling (*hrs, 16 hrs and 2 weeks) showed species specific changes in macrofaunal abundance. Decreasing density ranged from 10 to 65% for species of echinoderms (starfish and sea urchins but not brittle stars), tube dwelling polychaetes and molluscs at the two week sampling period. Density of some animals did not change others increased but these were not significant after 2 weeks.	Bergman and Hup (1992)
Benthic fauna	beam trawl and shrimp trawl; hard sandy bottom, shell debris and sandy-mud	North Sea, German coast	Preliminary report using video and photographs comparing trawled and untrawled areas. Presence and density of brittle stars, hermit crabs, other "large" crustaceans and flatfish was higher in the controls than the beam trawl site. Difference in sand ripple formation in trawled areas was also noted, looking disturbed not round and well developed. Found a positive correlation with damage to benthic animals and individual animal size. Found less impact with the shrimp trawl, diver observations confirmed low level of impact although the net was "festooned" with worms. Noted large megafauna, mainly crabs, in trawl tracks.	Rumhor et al. (1994)
Soft bottom macrofauna	beam trawl; very fine sand	North Sea, Dutch Sector	Compared animal densities before and after trawling and looked at fish stomach contents. Found that total mortality due to trawling varied between species and size class of fish, ranging from 4 to 139% of pretrawling values. (values> 100% indicate animals moving into the trawled area). Mortality for echinoderms was low, 3 to 19%, undetectable for some molluscs, esp. solid shells or small animals, while larger molluscs had a 12 to 85% mortality. Burrowing crustaceans had low mortality but epifaunal crustaceans approximated 30 % but ranged as high as 74%. Annelids were generally unaffected except for Pectinaria, a tube building animal. Generally mortality increased with number of times the area was trawled (once or twice). Dab were found to be the major savager, immigrating into the area and eating damaged animals.	Santbrink and Bergman (1994)

Source: Auster and Langton 1998.

Table 10 (continued). Studies of short-term impacts of fishing on benthic communities.

Taxa	Gear and Sediment Type	Region	Results	Reference(s)
Hermit Crabs	beam trawl	Irish Sea, U.K.	Compared the catch and diet of two species of hermit crab on trawled and control sites. Found significant increases in abundance on the trawl lines two to four days after trawling for both species but also no change for one species on one of two dates. Found a general size shift towards larger animals after trawling. Stomach contents weight was higher post-trawling for one species. Diets of the crabs were similar but proportions differed.	Ramsey et al. (1996)
Sand macrofauna and infauna	scallop dredge	Irish Sea	Compared experimental treatments based frequency of tows (i.e., 2,4,12,25). Bottom topography changes did not change grain size distribution, organic carbon, or chlorophyll content. Bivalve molluscs and peracarid crustaceans did not show significant changes in abundance or biomass. Polychaetes and urchins showed significant declines. Large molluscs, crustaceans and sand eels were also damaged. In general, there was selective elimination of fragile and sedentary components of the infauna as well as large epifaunal taxa.	Eleftheriou and Robertson (1992)

Source: Auster and Langton 1998.

Table 11. Studies of long-term impacts of fishing on benthic communities.

Habitat Type and Taxa Present	Time Period	Location	Effect	Reference
Sand; macrobenthos and meiofauna	2-7 months	Bay of Fundy	Experimental trawling in high energy area. Otter trawl doors dug up to 5 cm deep and marks were visible for 2 to 7 months. Initial significant effects on benthic diatoms and nematodes but no significant impact on macrofauna. No significant longterm effects.	Brylinsky et al. (1994)
Quartz sand; benthic infauna	5months	South Carolina Estuary	Compared benthic community in two areas, one open to trawling one closed, before and after shrimp season. Found variation with time but no relationship between variations and trawling per se.	Van Dolah et al. (1991)
Sandy; ocean quahogs	----	Western Baltic	Observed otter board damage to bivalves, especially ocean quahogs, and found an inverse relation between shell thickness and damage and a positive correlation between shell length and damage.	Rumhor and Krost (1991)
Subtidal shallows and channel; macrobenthos	100 years	Wadden Sea	Reviewed changes in benthic community documented over 100 years. Considered 101species. No long term trends in changing abundance for 42 common species, with 11 showing considerable variation. Sponges, coelenterates and bivalves suffered greatest losses while polychaetes showed the largest gains. Decrease subtidally for common species from 53 to 44 and increase intertidally from 24 to 38.	Reise (1982)
Intertidal sand; lug worms	4 years	Wadden Sea	Studied impact of lugworm harvesting versus control site. Machine digs 40 cm gullies. Immediate impact is a reduction in several benthic species and slow recovery for some the larger long-lived species like soft shelled clams. With one exception, a polychaete, the shorter-lived macrobenthic animals showed no decline. It took several years for the area to recover to prefishing conditions.	Beukema (1995)
Various habitat types; all species	---	North Sea	Review of fishing effects on the North Sea based primarily on ICES North Sea Task Force reports. Starfish, sea urchins and several polychaetes showed a 40 to 60 % reduction in density after beam trawling but some less abundant animals showed no change and one polychaete increased. At the scale of the North Sea the effect of trawling on the benthos is unclear.	Gislason (1994)

Source: Auster and Langton 1998.

Table 11 (continued). Studies of long-term impacts of fishing on benthic communities.

Habitat Type and Taxa Present	Time Period	Location	Effect	Reference
Sand; macrofauna	73 years	Kattegatt	Compared benthic surveys form 1911-1912 with 1984. Community composition has changed with only approximately 30% similarity between years at most stations. Primary change was a decrease in sea urchins and increase in brittle stars. Animals were also smaller in 1984. Deposit feeders have decreased while suspension feeders and carnivores have increased.	Pearson et al. (1985)
Subtidal shallows and channels; Macrofauna	55 years	Wadden Sea, Germany	Documented increase in mussel beds and associated species such as polychaetes and barnacles when comparing benthic survey data. Noted loss of oyster banks, *Sabellaria* reefs and subtidal sea grass beds. Oysters were overexploited and replaced by mussels; *Zostera* lost to disease. Conclude that major habitat shifts are the result of human influence.	Riesen and Reise (1982)
146 stations; Ocean Quahogs	---	Southern North Sea, Europe	Arctica valves were collected from 146 stations in 1991 and the scars on the valve surface were dated, using internal growth bands, as an indicator of the frequency of beam trawl damage between 1959 and 1991. Numbers of scars varied regionally and temporally and correlated with fishing.	Witbaard and Klein (1994)
Various habitats; Macrofauna	85 years	Western English Channel, UK	Discusses change and causes of change observed in benthic community based on historic records and collections. Discusses effects of fishing gear on dislodging hydroid and bryozoan colonies, and speculates that effects reduce settlement sites for queen scallops.	Holme (1983)
Gravel/sand; Macrofauna	3 years	Central California, USA	Compared heavily trawled area with lightly trawled (closed) area using Smith MacIntyre grab samples and video transect data collected over three years. Trawl tracks and shell debris were more numerous in heavily trawled area, as were amphinomid polychaetes and oligochaetes in most years. Rocks, mounds and flocculent material were more numerous at the lightly trawled station. Commercial fish were more common in the lightly trawled area as were epifaunal invertebrates. No significant differences were found between stations in term of biomass of most other invertebrates.	Engel and Kvitek (MS 1997)
Fine sand; razor clam	----	Barrinha, Southern Portugal	Evaluated disturbance lines in shell matrix of the razor clam and found an increase in number of disturbance lines with length and age of the clams. Sand grains were often incorporated into the shell suggestive of a major disturbance , such as trawling damage, and subsequent recovery and repair of the shell.	Gaspar et al. (1994)

Source: Auster and Langton 1998.

Table 11 (continued). Studies of long-term impacts of fishing on benthic communities.

Habitat Type and Taxa Present	Time Period	Location	Effect	Reference
Fine to medium sand; ocean quahogs	----	Southern New Jersey, USA	Compared areas unfished, recently fished and currently fished for ocean quahogs using hydraulic dredges. Sampled invertebrates with a Smith MacIntyre grab. Few significant differences in numbers of individuals or species were noted, no pattern suggesting any relationship to dredging.	MacKenzie (1982)
Gravel, shell debris and fine mud; Horse mussel community	8 years	Strangford Lough, Northern Ireland	Review paper of effects of queen scallop fishery on the horse mussel community. Compared benthic survey from the 1975-80 period with work in 1988. Scallop fishery began in 1980. *Modiolus* community has remained unchanged essentially from 1857 to 1980. The scallop fishery has a large benthic faunal bycatch, including horse mussels. Changes in the horse mussel community are directly related to the initiation of the scallop fishery and there is concern about the extended period it will take for this community to recover.	Brown (1989)
Shallow muddy sand; scallops	6 months	Maine, USA	Sampled site before, immediately after and up to 6 months after trawling. Loss of surficial sediments and lowered food quality of sediments, measured as microbial populations, enzyme hydrolyzable amino acids and chlorophyll *a*, was observed. Variable recovery by benthic community. Correlation with returning fauna and food quality of sediment.	Watling et al. (MS 1997)
Sand and seagrass; hard shelled clams and bay scallops	4 years	North Carolina, USA	Evaluated effects of clam raking and mechanical harvesting on hard clams, bay scallops, macroinvertebrates and seagrass biomass. In sand, harvesting adults showed no clear pattern of effect. With light harvesting seagrass biomass dropped 25% immediately but recovered in a year. In heavy harvesting seagrass biomass fell 65% and recovery did not start for >2 years and did not recover up to 4 years later. Clam harvesting showed no effect on macroinvertebrates. Scallop densities correlated with seagrass biomass.	Peterson et al. (1987)
Gravel pavement; benthic magafauna	Not known	Northern Georges Bank, USA	Used side scan, video and naturalist dredge sampling to characterize disturbed and undisturbed sites based on fishing activity records. Documented a gradient of community structure from deep, undisturbed to shallow disturbed sites. Undisturbed sites had more individual organisms, greater biomass, greater species richness and diversity and were characterized by an abundant bushy epifauna. Disturbed sites were dominated by hard-shelled molluscs, crabs and echinoderms.	Collie et al. (1997)

Source: Auster and Langton 1998.

Table 11 (continued). Studies of long-term impacts of fishing on benthic communities.

Habitat Type and Taxa Present	Time Period	Location	Effect	Reference
Sand; epifauna	3 year	Grand Banks, Canada	Experimentally trawled site 12 times each year within 31 to 34 hours for three years. Total invertebrate bycatch biomass declined over the three year study in trawls. Epibenthic sled samples showed lower biomass, averaging 25%, in trawled areas than reference sites. Scavenging crabs were observed in trawl tracks after first 6 hours and trawl damage to brittle stars and sea urchins was noted. No significant effects of trawling were found for four dominant species of mollusc.	Prena et al. (MS 1997)
Sand, shrimp and macrobenthos	7 months	New South Wales, Australia	Sampled macrofauna, pretrawling, after trawling and after commercial shrimp season using Smith McIntyre grab at experimental and control sites. Under water observation of trawl gear were also made. No detectable changes in macrobenthos was found or observed.	Gibbs et al. (1980)
Soft sediment; scallops and associated fauna	17 months	Port Phillip Bay, Australia	Sampled 3 months before trawling and 14 months after trawling. Most species showed a 20 to 30% decrease in abundance immediately after trawling. Dredging effects generally were not detectable following the next recruitment within 6 months but some animals had not returned to the trawling site 14 months post trawling.	Currie and Parry (1996)
Bryozoans; fish and associated fauna	----	Tasman Bay, New Zealand	Review of ecology of the coral-like bryozoan community and changes in fishing gear and practices since the 1950s. Points out the interdependence of fish with this benthic community and that the area was closed to fishing in 1980 because gear had developed which could fish in and destroy the benthic community thereby destroying the fishery.	Bradstock and Gordon (1983)
Various habitat types; diverse tropical fauna	5+years, ongoing	North West Shelf, Australia	Describes a habitat dependent fishery and an adaptive management approach to sustaining the fishery. Catch rates of all fish and large and small benthos show that in closed areas fish and small benthos abundance increased over 5 years while large benthos (>25 cm) stayed the same or increased slightly. In trawled areas all groups of animals declined. Found that settlement rate and growth to 25 cm was on the order of 15 years for the benthos.	Sainsbury et al. (In press)

Source: Auster and Langton 1998.

Table 11 (continued). Studies of long-term impacts of fishing on benthic communities.

Habitat Type and Taxa Present	Time Period	Location	Effect	Reference
Mudflat; commercial clam cultivation and benthos	7 months	South-east England	Sampled benthic community on a commercial clam culture site and control area at the end of a two year growing period, immediately after sampling, and again 7 months later. Infaunal abundance was greatest under the clam culture protective netting but species composition was similar to controls. Harvesting with a suction dredge changed the sediment characteristics and reduced the numbers of individual animals and species. Seven months later the site had essentially returned to the unharvested condition.	Kaiser et al. (1996a)
Sand; razor clam and benthos	40 days	Loch Gairloch, Scotland	Compared control and experimentally harvested areas using a hydraulic dredge at 1 day and 40 days after dredging. On day one a non-selective reduction in the total numbers of all infaunal species was apparent but no differences were observed after forty days.	Hall et al. (1990)
Sand and muddy areas; Macro-zoobenthos	3years; ongoing	German Bite, Germany	Investigated macro-zoobenthos communities around a sunken ship that had been "closed" to fishing for three years. Compared this site with a heavily fished area. Preliminary results show an increase in polychaetes and the bivalve Tellina in the fished, sandy, area. The data does not yet allow for a firm conclusion regarding the unfished area but there is some (nonsignificant) increase in species numbers and some delicate, sensitive species occurred within the protected zone.	Arntz et al. (1994)

Source: Auster and Langton 1998.

Table 12. Total commercial landings in millions of pounds by gear type from Maine to Virginia, in 1995.

GEAR TYPE	X 10^6 POUNDS	% OF TOTAL
PURSE SEINE, MENHADEN	739	44.90%
TRAWL, OTTER, BOTTOM	249	15.12%
UNKNOWN	142	8.60%
DREDGE, CLAM	118	7.17%
PURSE SEINE, HERRING	76	4.63%
POT/TRAP, LOBSTER	71	4.32%
TRAWL, OTTER, MIDWATER	69	4.25%
GILL NET, SINK, OTHER	58	3.55%
DIVING GEAR	28	1.70%
DREDGE, SCALLOP, SEA	22	1.32%
POTS + TRAPS, OTHER	21	1.28%
DREDGE, OTHER	17	1.02%
OTHER	14	0.82%
LONGLINE, BOTTOM	10	0.62%
LONGLINE, PELAGIC	6	0.36%
GILL NET, OTHER	3	0.19%
POUND NET	2	0.13%
PURSE SEINE, OTHER	1	0.04%
GRAND TOTAL	1650	100.00%

Source: USDC weighout file 1995.

Table 13. Fishing gear used to catch more than 1% of the total landings of the Mid-Atlantic Council-managed species, in 1995 weighout data.

Species \ Gear	Dredge, Scallop Sea	Dredge, SC/OQ	Floating Traps, Shallow	Gill Nets, Drift, Other	Gill Nets Sink, Other	Lines, Hand, Other	Lines, Long, Bottom	Otter Trawl, Bottom, Fish	Otter, Trawl, Bottom, Other	Pots and Traps, Fish	Pots and Traps, Lobster, Inshore	Pots and Traps, Lobster, Offshore	Pound Nets, Fish	Pound Nets, Other	Unknown
Atlantic Mackerel			X		X			X	X					X	
Black Sea Bass						X		X		X	X	X			X
Bluefish			X	X	X	X		X					X	X	X
Butterfish								X							X
Illex								X							
Loligo								X							
Ocean Quahog		X													
Scup			X					X		X	X	X			X
Spiny Dogfish					X		X	X							
Summer Flounder	X							X	X					X	X
Surfclam		X													

Table 14. Fishing gear managed by South Atlantic Fishery Management Council.

Gear Impacts and Council Action
Gear Used in Fisheries Under South Atlantic Council Fishery Management Plans

The following is a list of gear currently in use (or regulated) in fisheries managed under the South Atlantic Council fishery management plans. In general, if gear is not listed, it is prohibited or not commonly used in the fishery:

Snapper Grouper Fishery Management Plan

1. Vertical hook-and-line gear, including hand-held rod and manual or electric reel or "bandit gear" with manual, electric or hydraulic reel (recreational and commercial).

2. Spear fishing gear including powerheads (recreational and commercial).

3. Bottom longlines (commercial).
   - Prohibited south of a line running east of St. Lucie Inlet, Florida and in depths less than 50 fathoms north of that line.
   - May not be used to fish for wreckfish.

4. Sea bass pots (commercial).
   - May not be used or possessed in multiple configurations.
   - Pot size, wire mesh size and construction restrictions.
   - May not be used in the EEZ south of a line running due east of the NASA Vehicle Assembly Building, Cape Canaveral, Florida.

5. Special Management Zones (created under the Snapper Grouper FMP).
   - Sea bass pots are prohibited in all Special Management Zones.
   - Fishing may only be conducted with hand-held hook-and-line gear (including manual, electric, or hydraulic rod and reel) and spearfishing gear in specified Special Management Zones, however, and other specified Special Management Zones a hydraulic or electric real that is permanent affixed to a vessel ("bandit gear") and or spear fishing gear (or only powerheads) are prohibited.

Shrimp Fishery Management Plan

1. Shrimp trawls -- wide-ranging types including otter trawls, mongoose trawls, rock shrimp trawls, etc. (commercial).
   - Specified areas are closed to trawling for rock shrimp.

Red Drum Fishery Management Plan

1. No harvest or possession is allowed in or from the EEZ (no gear specified).

Golden Crab Fishery Management Plan

1. Crab traps (commercial).
   - May not be fished in water depths less than 900 feet in the northern zone and 700 feet in the middle and southern zones.
   - Trap size, wire mesh size, and construction restrictions.

Coral, Coral Reefs, and Live/Hard Bottom Habitat

1. Hand harvest only for allowable species (recreational and commercial).
2. Oculina Bank Habitat Area of particular concern.
   - Fishing with bottom longlines, bottom trawls, dredges, ports, or traps is prohibited.
   - Fishing vessels may not anchor, use and anchor and chain, or use a grapple and chain.

Coastal Migratory Pelagic Resource Fishery Management Plan

1. Hook-and-line gear, usually rod and reel or bandit gear, hand lines, flat lines, etc. (recreational and commercial).
2. Run-around gillnets or sink nets (commercial).
   - A gillnet must have a float line less than 1,000 yards in length to fish for coastal migratory pelagic species.
   - Gillnets must be at least 4-3/4 inch stretch mesh.
3. Purse seines for other coastal migratory species (commercial) with an incidental catch allowance for Spanish mackerel (10%) and king mackerel (1%).
4. Surface longlines primarily for dolphin.

Source: SAFMC 1998.

Table 15. Proposed impact of fishing gear on surfclam and ocean quahog EFH.

GEAR TYPE	KNOWN	POTENTIAL	NO EXPECTED
PURSE SEINE, MENHADEN			X
TRAWL, OTTER, BOTTOM		X	
UNKNOWN			X
DREDGE, CLAM		X	
PURSE SEINE, HERRING			X
POT/TRAP, LOBSTER		X	
TRAWL, OTTER, MIDWATER			X
GILL NET, SINK, OTHER		X	
DIVING GEAR			X
DREDGE, SCALLOP, SEA		X	
POTS + TRAPS, OTHER		X	
DREDGE, OTHER		X	
OTHER			X
LONGLINE, BOTTOM			X
LONGLINE, PELAGIC			X
GILL NET, OTHER		X	
POUND NET			X
PURSE SEINE, OTHER			X

Table 16. Matrix of prioritized threats in regards to their potential impact to surfclam and ocean quahog EFH along the Atlantic coast.

	IMPACTS																								
Threat	A. Change in topography	B. Fish blockage	C. Wetland alteration	D. Loss of SAV	E. Loss of riparian habitat	F. Erosion	G. Change in nature of substratight	H. Suspended sediments, turbidity	I. Change in temperature regime	J. Change in salinity regime	K. Change in circulation pattern	L. Hypoxia / Anoxia	M. Nutrient loading, Eutrophication	N. Change in photosynthesis regime	O. Water contamination	P. Sediment contamination	Q. Litter	R. Atmospheric deposition	S. Loss in benthic organisms	T. Physical damage to organism	U. Gene pool deterioration	V. Trophic alteration	W. Pathogens, disease	X. Displacement of species	Y. Introduction of exotic species
1.0 Coastal Development	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*					*	
2.0 Marine Mining	*		*	*		*	*	*				*		*					*					*	
3.0 Nonpoint Source Pollution	*			*			*	*	*	*	*	*	*	*	*	*	*	*	*				*	*	
4.0 Energy Production and Transport		*	*				*	*	*	*	*				*	*		*		*				*	
5.0 Artificial Reefs	*														*	*	*			*			*	*	
6.0 Dredging and Dredge Spoil Placement	*		*	*			*	*			*	*		*	*	*			*	*			*	*	
7.0 Port Development, Utilization, and Shipping	*		*				*	*				*		*	*	*		*	*	*				*	*
8.0 Aquaculture	*	*	*	*		*	*						*								*		*	*	*
9.0 Ocean Disposal							*	*				*	*	*	*	*							*	*	
10.0 Marinas and Recreational Boating			*	*		*	*	*	*	*		*			*	*	*	*	*	*			*	*	*
11.0 Sewage Treatment and Disposal			*				*	*	*			*	*	*	*	*			*				*	*	
12.0 Industrial Wastewater and Solid Wastes		*	*				*		*	*			*	*	*	*				*				*	
13.0 Introduced Species	*			*				*													*	*	*	*	

Table 17. Physical characteristics and nutrient loadings for eight major Mid-Atlantic estuaries.

Location	Volume (cubic ft.)	Surface Area (sq. mi.)	Average Daily Inflow (cfs)	Total Drainage Area (sq. mi.)	Estimated Nitrogen Loadings (tons/yr.)	Estimated Phosphorus Loadings (tons/yr.)
Delaware Bay	4.48×10^{11}	768	19,800	13,450	50,199 (High)	13,109 (High)
Delaware Inland Bays	3.85×10^{9}	33.3	300	292	1,425 (Med-High)	82 (Med.)
Chincoteague Bay	2.25×10^{10}	137	400	300	292 (Low)	84 (Low)
Chesapeake Bay	2.59×10^{12}	3,830	85,800	69,280	119,929 (High)	16,813 (High)
Albemarle-Pamlico Sound	1.08×10^{12}	2,949	46,000	29,574	28,224 (High)	3,565 (High)
Bogue Sound	1.31×10^{10}	102	1,300	680	710 (Low)	56 (Low)
New River	5.18×10^{9}	32	800	470	616 (Low)	112 (Med.)
Cape Fear River	1.22×10^{10}	38	10,100	9,090	8,102 (Med.)	1,486 (High)

Source: MARMRP 1994.

Table 18. Recent trends in selected parameters characterizing eutrophication, by estuary.

Parameter	St. Croix R./Cobscook Bay M	St. Croix R./Cobscook Bay S	Englishman Bay M	Englishman Bay S	Narraguagus Bay M	Narraguagus Bay S	Blue Hill Bay M	Blue Hill Bay S	Penobscot Bay T	Penobscot Bay M	Penobscot Bay S	Muscongus Bay M	Muscongus Bay S	Damariscotta River M	Damariscotta River S	Sheepscot Bay T	Sheepscot Bay M	Sheepscot Bay S	Kennebec/Andro River T	Kennebec/Andro River M	Kennebec/Andro River S
CHLOROPHYLL *A* (μg/l)	●	●	?	?	?	?	?	●	?	?	?	?	●	?	●	?	●	●	?	?	?
TURBIDITY	V*	●	?	Λ	?	?	?	●	?	?	?	?	?	?	●	●	●	●	?	?	?
NUISANCE ALGAE *event duration*	●	●	?	?	?	?	?	?	?	●	●	?	?	?	●	●	●	●	?	?	?
frequency of occurrence	●	●	?	?	?	?	?	?	?	●	●	?	?	●	●	●	●	●	?	?	?
TOXIC ALGAE *event duration*	●	●	?	●	?	●	?	●	?	●	●	?	?	?	●	●	●	●	?	?	?
frequency of occurrence	●	●	?	●	?	?	?	●	?	●	●	?	?	●	●	●	●	●	?	?	?
MACROALGAL	Λ	Λ*	?	Λ	?	?	?	●	?	?	?	●	●	?	●	●	●	●	?	?	?
EPIPHYTE ABUNDANCE	?	●	?	?	?	?	?	?	?	?	?	●	●	●	●	●	●	●	?	?	?
NITROGEN (mg/l)	●	●	?	●	?	?	●	●	?	V*	●	?	●	●	●	●	●	●	?	?	?
PHOSPHORUS (mg/l)	●	●	?	?	?	?	●	●	●	●	●	?	●	●	●	●	●	●	?	?	?
BOTTOM DO (mg/l)	Λ	●	?	●	?	?	●	●	Λ	Λ	●	●	●	●	●	Λ*	?	●	?	?	?
ANOXIA *event duration*	?	●	?	?	?	?	●	●	V	V	●	●*	?	●	●	?	?	●	?	?	?
frequency of occurrence	?	●	?	?	?	?	●	●	V	V	●	●*	?	●	●	?	?	?	?	?	?
spatial coverage	?	●	?	?	?	?	●	●	V	V	●	●*	?	●	●	?	?	●	?	?	?
HYPOXIA *event duration*	?	●	?	?	?	?	●	●	V	V	●	●*	?	●	●	?	?	●	?	?	?
frequency of occurrence	?	●	?	?	?	?	●	●	V	V	●	●*	?	●	●	?	?	?	?	?	?
spatial coverage	?	●	?	?	?	?	●	●	V	V	●	●*	?	●	●	?	?	●	?	?	?
BIOLOGICAL STRESS *event duration*	?	●	?	?	?	?	●	●	V	V	●	●*	?	●	●	?	?	●	?	?	?
frequency of occurrence	?	●	?	?	?	?	●	●	V	V	●	●*	?	●	●	?	?	?	?	?	?
spatial coverage	?	●	?	?	?	?	●	●	V	V	?	●*	?	●	●	?	?	●	?	?	?
PRIMARY PRODUCTIVITY	●*	●*	?	?	?	?	●	●	?	?	?	?	?	●*	●*	?	●	●	●*	●*	●*
PLANKTONIC COMMUNITY	?	●	?	●	?	?	?	●	?	?	?	?	?	●	●	?	●	●	●*	●*	●*
BENTHIC COMMUNITY	?	●	?	●	?	?	?	●	?	●	●	?	?	●	●	●	●	●	●*	●*	●*
SAV (spatial coverage)	●	Λ	?	?	?	?	●	●	?	?	?	?	?	●	●*	?	?	?	●*	●*	●*

Parameter	Casco Bay M	Casco Bay S	Saco Bay M	Saco Bay S	Great Bay M	Great Bay S	Hampton Harbor M	Hampton Harbor S	Merdmack River T	Merdmack River M	Plum Island Sound M	Plum Island Sound S	Massachusetts Bay S	Boston Harbor M	Boston Harbor S	Cape Cod Bay S
CHLOROPHYLL *A* (μg/l)	●	●	●	●	●	●	?	?	?	?	●	●	●	?	●	●
TURBIDITY	V	●	?	?	●	●	?	?	?	?	●	●	●	●	●	●
NUISANCE ALGAE *event duration*	●	●	●	●	●	●	●	●	?	?	●	●	●	?	?	●
frequency of occurrence	●	●	●	●	●	●	●	●	?	?	●	●	●	?	?	●
TOXIC ALGAE *event duration*	●	●	●	●	●	●	●	●	?	?	●	●	●	?	?	●
frequency of occurrence	●	●	●	●	●	●	●	●	?	?	●	●	●	?	?	●
MACROALGAL	●	Λ*	?	?	Λ*	Λ*	●	●	?	?	?	?	Λ	?	Λ*	Λ
EPIPHYTE ABUNDANCE	●	●	?	?	●*	●*	●	●	?	?	?	?	●	?	?	●
NITROGEN (mg/l)	●	●	●	●	●	●	?	?	?	?	●	●	●	?	●	Λ*
PHOSPHORUS (mg/l)	●	●	●	●	V	●	?	?	?	?	●	●	●	?	●	●
BOTTOM DO (mg/l)	Λ	Λ	Λ	●	●	●	?	?	?	?	●	●	●	?	●	V*
ANOXIA *event duration*	?	V	?	?	●	●	?	?	?	?	●	●	●	?	?	●
frequency of occurrence	?	V	?	?	●	●	?	?	?	?	●	●	●	?	●	●
spatial coverage	?	V	?	?	●	●	?	?	?	?	●	●	●	?	●	●
HYPOXIA *event duration*	V	V	?	?	●	●	?	?	?	?	●	●	●	?	?	●
frequency of occurrence	V	V	?	?	●	●	?	?	?	?	●	●	●	?	●	●
spatial coverage	V	V	?	?	●	●	?	?	?	?	●	●	●	?	●	●
BIOLOGICAL STRESS *event duration*	V	V	?	?	●	●	?	?	?	?	●	●	●	?	?	●
frequency of occurrence	●	V	?	?	●	●	?	?	?	?	●	●	●	?	●	●
spatial coverage	V	V	?	?	●	●	?	?	?	?	●	●	●	?	●	●
PRIMARY PRODUCTIVITY	?	?	?	?	●	●	?	?	?	?	●	●	●	?	●	●
PLANKTONIC COMMUNITY	?	●	?	?	?	●	?	?	?	?	●	●	●	?	●	●
BENTHIC COMMUNITY	●	●	?	?	●	●	?	?	?	?	●	●	①	●	②	●
SAV (spatial coverage)	●	V	?	?	Λ	Λ	●	●	?	V	●	●	V	●	V	V

? - unknown V - decreasing trend * - speculative response ● - no trend or shift Λ - increasing trend ① - shift from annelids to diverse ② - shift from a mixture of annelids and and crustaceans to crustaceans to crustaceans

Source: NOAA 1996,1997a-b.

Table 18 (continued). Recent trends in selected parameters characterizing eutrophication, by estuary.

Parameter	Buzzards Bay M	Buzzards Bay S	Narragansett Bay T	Narragansett Bay M	Narragansett Bay S	Gardiners Bay M	Gardiners Bay S	Long Island Sound T	Long Island Sound M	Long Island Sound S	Connecticut River T	Connecticut River M	Great South Bay M	Great South Bay S	Hudson R./Raritan Bay T	Hudson R./Raritan Bay M	Hudson R./Raritan Bay S	Barnegat Bay M	Barnegat Bay S	NJ Inland Bays M	NJ Inland Bays S	Delaware Bay T	Delaware Bay M	Delaware Bay S
CHLOROPHYLL *A* (µg/l)	?	Λ*	●	●	●	●	●	●	●	●	?	?	●	●	?	●	●*	●	●	Λ*	Λ*	●	●	●
TURBIDITY (concentration)	?	?	●	●	●	●	●	●*	V	V	?	?	●	●	?	?	?	?	?	?	?	●	●	●
NUISANCE ALGAE — *event duration*	?	?	Λ	Λ	Λ	●	?	?	Λ	Λ	?	?	?	?	?	●*	●*	●	●	●	Λ*	●	●	●
frequency of occurrence	?	?	Λ	Λ	Λ	●	?	?	Λ	Λ	?	?	?	?	?	●*	●*	●	●	●	Λ*	●	●	●
TOXIC ALGAE — *event duration*	?	?	?	?	?	?	?	●	●	●	?	?	●	●	?	●*	●*	●	●	●	●	●	●	●
frequency of occurrence	?	?	?	?	?	?	?	●	●	●	?	?	●	●	?	?	?	●	●	●	●	●	●	●
MACROALGAL ABUNDANCE	?	?	Λ	Λ	?	Λ	V	?	Λ	●	?	?	●	●	?	?	?	?	?	?	?	●	●	●
EPIPHYTE ABUNDANCE	?	?	?	?	?	?	?	?	Λ	●	?	?	●	●	?	?	?	?	?	?	?	●	●	●
NITROGEN (mg/l)	?	Λ*	●	●	●	●	V	●	Λ*	●	●	?	●	●	V	●	●	?	?	?	?	V	V	V
PHOSPHORUS (mg/l)	?	?	●	●	●	●	V	●	Λ	●	●	?	●	●	●	V	V	?	?	?	?	Λ	Λ	Λ
BOTTOM DO (mg/l)	?	?	Λ	Λ	●	●	●	Λ	Λ	V	?	?	●	●	?	Λ	V	?	?	?	?	Λ	Λ	●
ANOXIA — *event duration*	?	?	V	V	●	●	●	●	●	Λ	?	?	●	●	?	V	●	?	?	?	?	V	V	●
frequency of occurrence	?	?	V*	V*	?	?	?	?	?	Λ	?	?	?	?	?	V	?	?	?	?	?	?	?	?
spatial coverage	?	?	V	V	●	●	●	●	●	Λ	?	?	●	●	?	V	●	?	?	?	?	●	V	●
HYPOXIA — *event duration*	?	?	V	V	●	●	●	●	●	Λ	V	?	●	●	?	V	Λ	?	?	?	?	V	V	●
frequency of occurrence	?	?	V*	V*	V*	?	?	?	?	Λ	?	?	?	?	?	V	?	?	?	?	?	?	?	?
spatial coverage	?	?	V	V	●	●	●	●	●	Λ	V	?	●	●	?	V	●	?	?	?	?	●	V	●
BIOLOGICAL STRESS — *event duration*	?	?	V	V	●	●	●	●	●	Λ	?	?	●	●	?	V	●	?	?	?	?	V	V	●
frequency of occurrence	?	?	V*	V*	V*	?	?	?	?	Λ	?	?	?	?	?	?	?	?	?	?	?	?	?	?
spatial coverage	?	?	V	V	●	●	●	●	●	Λ	?	?	●	●	?	V	●	?	?	?	?	V	V	●
PRIMARY PRODUCTIVITY	?	③	?	?	?	●	●	?	●*	●	?	?	●	●	?	③	③	?	?	?	●*	●	●	●
PLANKTONIC COMMUNITY	?	?	④	●	④	●	●	?	●	●	?	?	●	●	?	●	●	●*	●*	?	●*	●	④	④
BENTHIC COMMUNITY	?	?	①	●	●	?	?	●	●	●	?	?	●	●	⑤	●	①	●*	●*	?	?	?	?	②
SAV (spatial coverage)	V	V	●	●	●	Λ	Λ	V	V	V	?	?	V	V	?	V	V	?	?	?	?	●	●	●

Parameter	DE Inland Bays M	DE Inland Bays S	MD Inland Bays M	MD Inland Bays S	Chincoteague Bay S	Chesapeake Bay T	Chesapeake Bay M	Chesapeake Bay S	Patuxent River T	Patuxent River M	Potomac River T	Potomac River M	Rappahannock River T	Rappahannock River M	York River T	York River M	James River T	James River M	Chester River T	Chester River M	Choptank River T	Choptank River M	Tan-/Poc. Sounds T	Tan-/Poc. Sounds M
CHLOROPHYLL *A* (µg/l)	●	●	V*	●	?	●*	●	●	Λ	●	●	V	Λ	Λ	Λ	Λ	Λ	Λ	●	●	●	●	Λ	Λ
TURBIDITY (concentration)	●	●	●	?	●	●	●	●	●	●	●	V	●	●	●	●	●	●	●	●	●	V	●	V
NUISANCE ALGAE — *event duration*	●	●	●	●	?	●	●	●	●	?	V	●	●	●	●	●	●	●	?	?	●	●	?	●
frequency of occurrence	●	●	●	●	?	●	●	●	●	●	V	V	●	●	●	●	●	●	?	?	●	●	?	●
TOXIC ALGAE — *event duration*	?	?	?	?	?	●	●	●	?	?	●	●	●	●	●	●	●	●	?	?	●	●	?	●
frequency of occurrence	?	?	?	?	?	●	●	●	?	?	●	●	●	●	●	●	●	●	?	?	●	●	?	●
MACROALGAL ABUNDANCE	?	?	?	?	?	●	●	●	●	●	V	●	●	●	●	●	●	●	?	?	●	●	?	Λ
EPIPHYTE ABUNDANCE	●	●	?	?	?	●	?	●	?	?	?	?	●	●	●	●	●	●	?	?	●	V	?	Λ
NITROGEN (mg/l)	●	●	V*	?	V*	●	Λ*	●	V	V	●	●	●	●	●	●	●	●	●	●	●	●	?	V
PHOSPHORUS (mg/l)	●	●	V	●	V*	●	V*	●	V	V	V	●	Λ	●	Λ	●	●	●	●	●	●	V	?	V
BOTTOM DO (mg/l)	●	●	●	●	●	●	●	●	Λ	●	Λ	●	●	V	●	●	●	V	●	●	●	●	●	●
ANOXIA — *event duration*	?	?	●	?	?	●	●	●	●	●	●	●	?	?	●	●	●	?	●	●	●	●	●	●
frequency of occurrence	?	?	?	?	?	●	●	?	●	●	●	●	?	?	?	?	?	?	●	●	●	Λ	●	●
spatial coverage	?	?	●	●	?	●	Λ	●	●	●	?	●	?	?	●	●	●	?	●	●	●	●	●	●
HYPOXIA — *event duration*	●	●	●	?	?	●	●	●	●	●	●	●	?	?	●	●	●	?	●	●	●	●	●	●
frequency of occurrence	?	?	?	?	?	●	●	?	●	●	●	●	?	?	?	?	?	?	●	●	●	Λ	●	●
spatial coverage	●	●	●	●	?	●	Λ	●	●	●	Λ	●	?	?	●	●	●	?	●	●	●	●	●	●
BIOLOGICAL STRESS — *event duration*	●	●	●	●	?	●	●	●	V	●	●	●	●	?	●	●	●	?	●	●	●	●	●	●
frequency of occurrence	?	?	?	?	?	●	●	?	?	●	●	V	?	?	?	?	?	?	●	●	●	Λ	●	●
spatial coverage	●	●	●	●	?	●	Λ	●	V	●	V	●	●	?	●	●	●	?	●	●	●	●	●	●
PRIMARY PRODUCTIVITY	●	●	?	?	?	●	●	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
PLANKTONIC COMMUNITY	①	●	●	●	?	●	●	●	●	●	●	●	●	●	●	●	●	●	?	●	●	●	?	?
BENTHIC COMMUNITY	●	●	●	●	?	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	?	?
SAV (spatial coverage)	●	●	●	?	Λ	●	Λ	Λ	Λ	●	Λ	Λ	●	Λ	●	●	●	Λ	●	Λ	●	Λ	?	Λ

? - unknown V - decreasing trend * - speculative response Λ - increasing trend ● - no trend or shift ① - shift to diverse mixture ② - shift to annelids and crustaceans ③ - shift to pelagic ④ - shift to diatoms ⑤ - shift to mollusks

Source: NOAA 1996,1997a-b.

Table 18 (continued). Recent trends in selected parameters characterizing eutrophication, by estuary.

Parameter	Albemarle/Pamlico Sounds	Pamlico River	Neuse River	Bogue Sound	New River	Cape Fear River	Winyah Bay	N & S Santee River	Charleston Harbor	Stono/N. Edisto River	St. Helena Sound	Broad River	Savannah River	Ossabaw Sound	St. Catherine/Sapelo Sound	Altamaha River	St. Andrews/ St. Simon Sound	St. Marys/Cumberland Sound	St. Johns River	Indian River	Biscayne Bay
	T M S	M	T M	M S	M S	T M S	T M S	T M	T M S	M S	M S	M S	T M S	T M S	M S	T M S	T M S	M S	T M S	S	M S
CHLOROPHYLL *A* (µg/l)	? ? •*	Λ	• Λ	? •	? ?	? ? •	? ? •	? ?	? ? ?	? ?	? ?	? ?	? ? ?	? •* ?	? ?	? ? ?	? ? ?	? ?	• • •	Λ*	• •
TURBIDITY (concentrations)	V ? ?	?	• ?	? •	? ?	Λ ? ?	Λ Λ •	V V	? Λ Λ	Λ Λ	• ?	Λ •	Λ • ?	? ? ?	? ?	? • ?	? ? ?	? ?	• • •	•	• V
NUISANCE ALGAE — *event duration*	? • ?	?	V Λ	• •	? ?	? ? ?	•* •* •*	•* •*	? • •*	? ?	? ?	? ?	? • •	? • •	• •	? • ?	? • •	• •	• • •	•	•* •*
frequency of occurrence	? • ?	?	V Λ	• •	? ?	? ? ?	•* •* •*	•* •*	? • •*	? ?	? ?	? ?	? • •	? • •	• •	? • •	? • •	• •	• • •	•	•* •*
TOXIC ALGAE — *event duration*	? • ?	?	V Λ	• ?	? ?	? ? ?	•* •* •*	•* •*	? • •*	? ?	? ?	? ?	? • •	? • •	• •	? • •	? • •	• •	• • •	•	•* •*
frequency of occurrence	? • ?	?	V Λ	• •	? ?	? ? ?	•* •* •*	•* •*	? • •*	? ?	? ?	? ?	? • •	? • •	• •	? • •	? • •	• •	• • •	•	•* •*
MACROALGAL ABUNDANCE	V ? ?	?	? •	? •	? ?	• • •	? ? ?	•* •*	Λ ? ?	• •	? ?	? ?	? • •	? ? ?	• •	? • •	• • •	• •	• • •	•	• •
EPIPHYTE ABUNDANCE	? ? ?	?	? •	? ?	? ?	• • •	? ? ?	•* •*	? ? ?	• •	? ?	? ?	? • •	? ? ?	• •	? • •	• • •	• •	• • •	?	• •
NITROGEN (mg/l)	? • ?	•	Λ Λ	• •	? ?	? ? ?	V V V	V V	V V V	V ?	V ?	• ?	• • •	• • ?	Λ* ?	V V ?	Λ* Λ* ?	• ?	• • •	•*	V Λ
PHOSPHORUS (mg/l)	? • ?	V	• •	• •	? ?	? ? ?	V V V	V V	V V V	V V	• ?	• •	• • •	• • ?	Λ* ?	• • ?	Λ* Λ* ?	• ?	• • •	•*	• V
BOTTOM DO (mg/l)	? ? ?	V	V V	•* •	? ?	? ? ?	? ? ?	? ?	? ? ?	? ?	? ?	? ?	? Λ ?	? ? ?	? ?	? ? ?	? ? ?	? ?	• • •	•	V V
ANOXIA — *event duration*	? ? ?	•	? Λ	• •	? ?	? ? ?	? ? ?	? ?	? ? ?	? ?	? ?	? ?	? ? ?	? ? ?	? ?	? ? ?	? ? ?	? ?	• • •	•	• •
frequency of occurrence	? ? ?	•	? Λ	• •	? ?	? ? ?	? ? ?	? ?	? ? ?	? ?	? ?	? ?	? ? ?	? ? ?	? ?	? ? ?	? ? ?	? ?	• • •	•	• •
spatial coverage	? ? ?	•	Λ Λ	• •	? ?	? ? ?	? ? ?	? ?	? ? ?	? ?	? ?	? ?	? ? ?	? ? ?	? ?	? ? ?	? ? ?	? ?	• • •	•	• •
HYPOXIA — *event duration*	? ? ?	•	Λ Λ	• •	? ?	? ? ?	? ? ?	? ?	? ? ?	? ?	? ?	? ?	? ? ?	? ? ?	? ?	? ? ?	? ? ?	? ?	• • •	•	• •
frequency of occurrence	? ? ?	•	Λ Λ	• •	? ?	? ? ?	? ? ?	? ?	? ? ?	? ?	? ?	? ?	? ? ?	? ? ?	? ?	? ? ?	? ? ?	? ?	• • •	•	• •
spatial coverage	? ? ?	•	Λ Λ	• •	? ?	? ? ?	? ? ?	? ?	? ? ?	? ?	? ?	? ?	? Λ ?	? ? ?	? ?	? ? ?	? ? ?	? ?	• • •	•	• •
BIOLOGICAL STRESS — *event duration*	? ? ?	•	Λ Λ	• •	? ?	? ? ?	? ? ?	? ?	? ? ?	? ?	? ?	? ?	? ? ?	? ? ?	•* ?	•* •* ?	•* •* ?	•* ?	• • •	•	• •
frequency of occurrence	? ? ?	•	Λ Λ	• •	? ?	? ? ?	? ? ?	? ?	? ? ?	? ?	? ?	? ?	? ? ?	? ? ?	•* ?	• • ?	•* •* ?	•* ?	• • •	•	• •
spatial coverage	? ? ?	•	Λ Λ	• •	? ?	? ? ?	? ? ?	? ?	? ? ?	? ?	? ?	? ?	? Λ ?	? ? ?	•* ?	•* •* ?	•* •* ?	•* ?	• • •	•	• •
PRIMARY PRODUCTIVITY	• ? ?	•	•* •	? ?	? ?	? ? ?	? ? •	? ?	? ? ?	? ?	• ?	? ?	? ? ?	? ? ?	? ?	? ? ?	? ? ?	? ?	? ? ?	•*	? •
PLANKTONIC COMMUNITY	• ? ?	•	① •	• •	? ?	? ? ?	? ? •	? ?	• ? ?	? ?	? ?	? ?	? ? ?	? ? ?	? ?	? ? ?	? ? ?	? ?	• • •	?	? •
BENTHIC COMMUNITY	? ? ?	?	? ?	? •*	? ?	? ? ?	? ? •	? ?	? • •	• •	? ?	? ?	? • ?	? ? ?	? ?	? ? ?	? ? ?	? ?	• • •	②	? •
SAV (spatial coverage)	V V ?	V	• V	? ?	? ?	? ? ?	? ? •	? ?	? Λ ?	• •	? ?	? ?	? • •	? ? ?	• •	? • •	? • •	• •	V V •	V*	• Λ
WETLANDS (spatial coverage)	• • ?	•	• •	• •	? ?	? ? ?	? • •	• •	? • •	• •	• •	• •	? V* V*	? ? ?	? ?	? ? ?	? ? ?	? ?	? ? ?	V*	V V

? - unknown V - decreasing trend * - speculative response • - no trend or shift Λ - increasing trend ① - shift to diverse mixture ② - shift to annelids and crustaceans

Source: NOAA 1996,1997a-b.

Table 19. Surfclam landings : both state and federal waters, for 1996 and 1997.

Region	1996			1997	
	Bushels	Value		Bushels	Value
New England States	140,774	$2,094,568		657	$16,831
Mid-Atlantic States	3,598,489	$36,179,934		3,320,819	$33,802,411
Total	3,739,263	$38,274,502		3,321,476	$33,819,242

Note: 1 bushel = 17 pounds of surfclam meat

Source: NMFS Unpublished Landings Data, Woods Hole, MA

Table 20. New Jersey inshore surfclam fishery for fishing years 1995/96 through 1997/98.

Season (Oct - May)	Quota (bu)	Landings (bu)	Bushels Unharvested	Percent Unharvested
FY 97/98	600,000	467,569	132,431	22%
FY 96/97	600,000	468,377	131,623	22%
FY 95/96	600,000	566,120	33,880	6%

Note: 1 bushel = 17 pounds of surfclam meat

Source: New Jersey Division of Fish, Game, and Wildlife

Table 21. **New York inshore quotas and landings of surfclams.**

Year	Quota (bu)	Harvest (bu)	Percent Over or Under Quota
1990	(none)	720,473	
1991	(none)	713,019	
1992	(none)	719,351	
1993	(none)	856,366	
1994	500,000	523,281	5 % over
1995	500,000	420,855	16 % under
1996	500,000	451,492	10 % under
1997	500,000	389,014	22 % under
1998	500,000	135,342 (Jan - Jun only)	54% under (Jan - Jun only)

Note: 1 bushel = 17 pounds of surfclam meat

Source: NY Dept. of Environmental Conservation

Table 22. NY Atlantic surfclam landings: January - June comparison, for 1994 through 1998.

Year	First Quarter	Second Quarter	Half-Year Total
1994	119,623	119,251	238,874
1995	106,689	105,063	211,752
1996	117,738	119,053	236,791
1997	112,196	109,928	222,124
1998	76,003	59,339	135,342

Note: 1 bushel = 17 pounds of surfclam meat

Source: NY Dept. of Environmental Conservation

Table 23. Surfclam fishery in the EEZ: number of vessels, trips, hours at sea, hours fishing, landings (bushels), landings per unit Effort (bu/hour fishing), and average landings per vessel.

Year	Class	Vessels	Trips	Hours at Sea	Hours Fishing	Landings	LPUE*	Ave. Bu. per Boat
1979	1	26	584	9,080	5,787	103,665	17	3,987
	2	61	1,992	39,369	22,670	484,151	21	7,937
	3	75	2,622	59,298	34,326	1,086,393	32	14,485
	All	162	5,198	107,747	62,783	1,674,209	26	10,335
1980	1	14	406	5,674	3,650	79,621	19	5,687
	2	54	2,164	38,743	23,996	597,646	24	11,068
	3	59	2,323	53,098	31,153	1,246,766	40	21,132
	All	127	4,893	97,515	58,799	1,924,033	32	15,150
1981	1	16	328	4,701	2,927	64,942	22	4,059
	2	48	1,502	25,029	14,507	572,063	37	11,918
	3	59	2,198	47,664	23,555	1,339,433	56	22,702
	All	123	4,028	77,394	40,989	1,976,438	47	16,069
1982	1	15	511	7,535	4,908	97,833	20	6,522
	2	47	2,037	32,906	20,916	614,069	28	13,065
	3	53	2,734	55,855	29,721	1,290,928	42	24,357
	All	115	5,282	96,296	55,545	2,002,830	35	17,416
1983	1	14	408	6,323	4,025	113,753	28	8,125
	2	48	2,035	30,354	19,302	818,966	40	17,062
	3	55	2,341	48,934	25,279	1,479,221	58	26,895
	All	117	4,784	85,611	48,606	2,411,940	48	20,615
1984	1	15	319	4,897	3,142	126,421	40	8,428
	2	50	1,763	27,341	16,755	1,152,763	66	23,055
	3	54	1,638	34,893	16,499	1,687,842	96	31,256
	All	119	3,720	67,131	36,396	2,967,026	77	24,933
1985	1	13	217	2,075	1,089	87,791	78	6,753
	2	49	1,307	15,986	7,415	962,313	122	19,639
	3	68	1,582	32,533	11,840	1,859,226	149	27,342
	All	130	3,106	50,594	20,344	2,909,330	135	22,379
1986	1	13	164	1,986	984	81,895	83	6,300
	2	54	1,037	14,679	6,094	964,583	143	17,863
	3	77	1,540	34,724	10,676	2,134,164	189	27,716
	All	144	2,741	51,389	17,754	3,180,642	167	22,088
1987	1	11	159	2,709	1,234	68,006	55	6,182
	2	54	1,143	17,432	7,771	923,127	113	17,095
	3	77	1,433	31,303	8,840	1,828,686	199	23,749
	All	142	2,735	51,444	17,845	2,819,819	151	19,858
1988	1	10	207	3,466	1,895	93,740	49	9,374
	2	51	1,304	19,392	8,743	1,023,364	106	20,066
	3	73	1,527	33,221	9,487	1,914,577	196	26,227
	All	134	3,038	56,079	20,125	3,031,681	143	22,624

Table 23(continued). Surfclam fishery in the EEZ: number of vessels, trips, hours at sea, hours fishing, landings (bushels), landings per unit Effort (bu/hour fishing), and average landings per vessel.

Year	Class	Vessels	Trips	Hours at Sea	Hours Fishing	Landings	LPUE*	Ave Bu/Boat
1989	1	9	185	3,148	1,904	87,151	44	9,683
	2	50	1,186	15,481	7,357	947,092	117	18,942
	3	76	1,508	26,324	9,610	1,804,165	182	23,739
	All	135	2,879	44,953	18,871	2,838,408	143	21,025
1990	1	8	237	3,931	2,470	69,376	28	8,672
	2	45	1,086	12,450	6,233	961,195	138	21,360
	3	75	1,636	25,067	11,043	2,083,405	184	27,779
	All	128	2,959	41,448	19,746	3,113,976	150	24,328
1991	1&2	25	971	13,853	6,300	808,893	120	32,356
	3	50	1,470	24,942	12,765	1,864,520	144	37,290
	All	75	2,441	38,795	19,065	2,673,413	136	35,646
1992	1&2	19	834	10,682	4,873	738,640	142	38,876
	3	40	1,747	29,874	17,521	2,073,630	117	51,841
	All	59	2,581	40,556	22,394	2,812,270	123	47,666
1993	1&2	17	770	9,294	4,713	778,766	164	45,810
	3	36	1,697	28,538	16,333	2,055,951	126	57,110
	All	53	2,467	37,832	21,046	2,834,717	134	53,485
1994	1&2	15	808	9,778	5,597	826,366	148	55,091
	3	32	1,668	30,844	17,980	2,020,304	112	63,135
	All	47	2,476	40,622	23,577	2,846,670	121	60,567
1995	1&2	13	793	10,800	5,739	810,125	141	62,317
	3	24	1,453	26,169	15,622	1,735,180	111	72,299
	All	37	2,246	36,969	21,361	2,545,305	119	68,792
1996	1&2	12	892	12,821	7,482	958,937	128	79,911
	3	22	1,286	24,570	15,551	1,610,382	104	73,199
	All	34	2,178	37,391	23,033	2,569,319	112	75,568
1997	1&2	11	803	11,509	6,509	837,198	129	76,109
	3	22	1,316	24,643	15,220	1,576,377	104	71,654
	All	33	2,119	36,152	21,729	2,413,575	111	73,139

* LPUE values are computed from only those trips which have both Hours Fished and Landings data reported. The Hours Fished and Landings values displayed in this table are gross reported totals, and hence may not be divided to calculate LPUE. Hours Fished values are thought to be under-reported in the Northern New Jersey region between 1986 and 1990, due to strict limits on surfclam fishing time in the management regime prior to Amendment #8.
Note: 1 bushel=17 pounds of surfclam meat
Source: NMFS Clam Vessel Logbook Files.

Table 24. Ocean quahog landings: both state and federal waters (excludes Maine fishery), for 1996 and 1997.

Region	1996			1997	
	Bushels	Value		Bushels	Value
New England States	2,352,644	$9,817,239		2,204,473	$9,128,339
Mid-Atlantic States	2,241,687	$9,232,296		2,074,586	$8,654,997
Total	4,594,331	$19,049,535		4,279,059	$17,783,336

Note: 1 bushel = 10 pounds of ocean quahog meat

Source: NMFS Unpublished Landings Data, Woods Hole, MA

Table 25. Ocean quahog fishery in the EEZ: number of vessels, trips, hours at sea, hours fishing, landings (bushels), landings per unit effort (bu/hour fishing), and average landings per vessel.

Year	Class	Vessels	Trips	Hours at Sea	Hours Fishing	Landings	LPUE*	Ave Bu. per Boat
1979	1 & 2	22	735	10,325	4,333	477,346	109	21,698
	3	37	1,966	35,635	19,545	2,557,350	127	69,118
	All	59	2,701	45,960	23,878	3,034,696	124	51,436
1980	1 & 2	19	561	7,836	3,528	354,110	95	18,637
	3	33	1,950	39,488	22,025	2,607,679	114	79,021
	All	52	2,511	47,324	25,553	2,961,789	111	56,957
1981	1 & 2	12	399	5,965	2,793	248,498	88	20,708
	3	35	2,011	37,914	20,859	2,639,789	125	75,423
	All	47	2,410	43,879	23,652	2,888,287	121	61,453
1982	1 & 2	12	274	4,414	2,391	187,447	77	15,621
	3	31	2,146	39,956	21,515	3,053,328	136	98,494
	All	43	2,420	44,370	23,906	3,240,775	130	75,367
1983	1 & 2	8	225	3,561	1,936	159,214	81	19,902
	3	29	2,243	40,718	21,072	3,056,426	142	105,394
	All	37	2,468	44,279	23,008	3,215,640	137	86,909
1984	1 & 2	16	467	7,266	3,873	369,529	92	23,096
	3	41	2,738	51,563	26,845	3,593,438	129	87,645
	All	57	3,205	58,829	30,718	3,962,967	124	69,526
1985	1 & 2	17	611	9,352	4,756	483,004	99	28,412
	3	47	3,101	58,462	28,988	4,086,505	138	86,947
	All	64	3,712	67,814	33,744	4,569,509	133	71,399
1986	1 & 2	16	471	8,795	4,159	441,192	103	27,575
	3	56	2,714	51,648	25,292	3,726,013	146	66,536
	All	72	3,185	60,443	29,451	4,167,205	140	57,878
1987	1 & 2	16	333	7,359	3,405	359,042	105	22,440
	3	55	2,995	59,220	29,482	4,383,983	146	79,709
	All	71	3,328	66,579	32,887	4,743,025	142	66,803
1988	1 & 2	11	221	4,555	2,088	251,674	114	22,879
	3	51	2,818	60,554	31,213	4,217,699	133	82,700
	All	62	3,039	65,109	33,301	4,469,373	132	72,087
1989	1 & 2	13	540	9,823	4,945	650,059	124	50,005
	3	56	3,055	66,364	34,671	4,280,221	121	76,433
	All	69	3,595	76,187	39,616	4,930,280	122	71,453
1990	1 & 2	14	496	11,002	6,470	623,346	96	44,525
	3	42	2,753	62,569	34,614	3,999,071	115	95,216
	All	56	3,249	73,571	41,084	4,622,417	112	82,543

Table 25 (continued). Ocean quahog fishery in the EEZ: number of vessels, trips, hours at sea, hours fishing, landings (bushels), landings per unit effort (bu/hour fishing), and average landings per vessel.

Year	Class	Vessels	Trips	Hours at Sea	Hours Fishing	Landings	LPUE*	Ave Bu. per Boat
1991 - Excludes Maine Fishery								
	1&2	11	545	11,889	6,343	731,634	115	66,512
	3	38	2,824	68,002	39,531	4,108,190	103	108,110
	All	49	3,369	79,911	45,874	4,839,824	104	98,772
1992 - Excludes Maine Fishery								
	1&2	9	527	11,267	5,464	693,971	127	77,108
	3	34	2,563	61,914	31,678	4,244,729	132	124,845
	All	43	3,090	73,181	37,142	4,938,700	131	114,853
1993 - Excludes Maine Fishery								
	1&2	8	535	12,764	6,442	720,702	112	90,088
	3	28	2,655	67,549	38,860	4,091,239	105	146,116
	All	36	3,190	80,313	45,302	4,811,941	106	133,665
1994 - Excludes Maine Fishery								
	1&2	7	444	10,748	5,580	580,198	104	82,885
	3	29	2,683	65,734	38,764	4,031,197	104	139,007
	All	36	3,127	76,482	44,344	4,611,395	104	128,094
1995 - Excludes Maine Fishery								
	1&2	6	480	12,168	7,116	692,491	97	115,415
	3	30	2,496	60,216	32,752	3,935,832	120	131,194
	All	36	2,976	72,384	39,868	4,628,323	116	128,565
1996 - Excludes Maine Fishery								
	1&2	5	429	11,439	6,026	678,804	113	135,761
	3	31	2,116	52,328	27,104	3,712,624	137	119,762
	All	36	2,545	63,767	33,130	4,391,428	133	121,984
1997 - Excludes Maine Fishery								
	1&2	6	413	12,570	6,860	684,684	100	114,114
	3	25	1,881	52,535	27,154	3,594,375	132	143,775
	All	31	2,294	65,105	34,014	4,279,059	126	138,034

Note: 1 bushel = 10 pounds of ocean quahog meat

Table 26. Maine ocean quahog fishery: number of vessels, trips, hours at sea, hours fishing, landings (bushels), landings per unit effort (bu/hour fishing), and average landings per vessel.

Year	Class	Vessels	Trips	Hours at Sea	Hours Fishing	Landings	LPUE*	Ave. Bu. perBoat
1991	All	45	2,221	23,465	17,162	36,679	2.0	815
1992	All	53	1,677	17,711	13,469	24,839	1.8	469
1993	All	33	685	9,732	5,748	17,144	3.0	520
1994	All	30	792	7,189	5,102	21,480	4.2	716
1995	All	30	1,052	8,233	5,747	37,912	6.6	1,264
1996	All	25	1,374	11,811	8,483	47,025	5.5	1,881
1997	All	34	1,945	16,285	11,829	72,706	6.1	2,138

NOTE 1: This table includes ocean quahog landings records from the Clam logbooks ONLY, and does NOT include landings submitted in the Multispecies logbooks.

NOTE 2. The bushel unit used in the Maine fishery measures 1.2445 cubic feet. The standard bushel unit used in the industrial ITQ fishery outside Maine is 1.88 cubic feet.

NOTE 3: 1 bushel = 10 pounds of ocean quahog meat

* LPUE values are computed from only those trips which have both Hours Fished and Landings data reported. The Hours Fished and Landings values displayed in this table are gross reported totals, and hence may not be divided to calculate LPUE.

Source: NMFS Clam Vessel Logbook Files

Table 27. Top 10 ports of landing for surfclams and ocean quahogs, in 1997, ranked by pounds of landed meat.

1997 Top 10 Ports of Landing for Surfclams and Ocean Quahogs, Ranked by Pounds of Landed Meats			
Rank	Port	Number of Vessels	Number of Trips
1)	Atlantic City, NJ	27	1,914
2)	New Bedford, MA	12	798
3)	Pt. Pleasant, NJ	25	1,061
4)	Wildwood, NJ	6	468
5)	"Other New York"	1	12
6)	Ocean City, MD	5	349
7)	Warren, RI	2	131
8)	Shinnecock, NY	5	121
9)	Cape May, NJ	3	63
10)	Jonesport, ME	23	1,247
Source: NMFS Unpublished Landings Data, Woods Hole, MA			

Note that the numbers of vessels which landed in each port may not be summed to get a "fleet total," since some vessels landed in more than one port.

Source: NMFS Unpublished Landings Data, Woods Hole, MA.

Table 28. Washington and Hancock County demographics.

	Maine	Washington County	Hancock County
Population (1995)	1,241,382	36,156 (2.9% of state total)	49,272 (3.3% of state total)
Retail Economic Activity (1994)	$9 billion	$149.4 million (1.6% of state total)	$411.1 million (4.5% of state total)
Unemployment Rate (1996)		7.5%	6.0%
Median Household Income	$27,854.00	$19,993.00	$25,247.00
Persons Below Poverty Level (1990 census)	10.8%	19.3%	10.0%
Families with children below poverty level (1990 census)	11.8%	21.6%	9.9%
Population (1990 census) % urban/rural	44.6% / 55.4%	9% / 91%	20.1% / 79.9%
Population (1990 census) % high school graduate or higher	78.8%	78.2%	83.3%
Population (1990 census) % bachelor's degree or higher	18.8%	12.7%	21.4%

Source: Finlayson, pers. comm

Table 29. List of number of animals, by species, captured during the 1997 NMFS Clam Survey. All tows are included. The list is ordered by total number caught.

Total #	Animal	Species
6	Sea Scallop (Clapper)	*Placopecten magelanicus*
6	Southern Quahog (Clapper)	*Mercenaria campechianus*
12	Ten-Ridged Whelk	*Neptunea decemcostata*
67	Spider Crab (Unclassified)	*Majidae* spp.
75	Knobbed Whelk	*Busycon carica*
81	Horseshoe Crab	*Limulus polyphemus*
101	Stimpson's Whelk	*Colus stimpsoni*
104	Dog Whelk	*Nassaruis* spp.
121	Horse Mussel	*Modiolus modiolus*
154	Northern Cardita	*Venercardia borealis*
155	False Quahog	*Pitar morrhuana*
167	Pastel Swimming Crab	*Ovalipes guadalupensis*
198	Channeled Whelk	*Busycon Canaliculatum*
245	Shark's Eye or Lobed Moonshell	*Polinices duplicatus*
303	Waved Whelk	*Buccunum undatum*
351	Southern Quahog (Live)	*Mercenaria campechianus*
423	Jonah Crab	*Cancer borealis*
441	Lady Crab	*Ovalipes ocellatus*
647	Hermit Crab (Unclassified)	*Diogenidae/Paguridae* spp.
679	Chestnut Astarte	*Astarte castanea*
787	Sea Scallop (Live)	*Placopecten magelanicus*
1,052	Northern Moon Shell	*Lunatia heros*
1,630	Common Razor Clam	*Ensis directus*
1,873	Surfclam (Clapper)	*Spisula solidissima*
2,206	Starfish (Unclassified)	*Asteriidae* spp.
2,233	Boreal Asterias	*Asterias vulgaris*
2,593	Ocean Quahog (Clapper)	*Arctica islandica*
3,073	Margined Seastar	*Astropecten* spp.
3,486	Rock Crab	*Cancer irroratus*
36,221	Surfclam (Live)	*Spisula solidissima*
66,682	Ocean Quahog (Live)	*Arctica islandica*
126,172	Total	

Source: Weinberg pers. comm.

Table 30. Cetaceans and turtles found in survey area.

Scientific name	Common name	Estimated Min. Num. in Study Area	Endangered	Threatened
LARGE WHALES				
Balaenoptera physalus	fin whale	1,102	X	
Megaptera novaeangliae	humpback whale	684	X	
Balaenoptera acutorostrata	minke whale	162		
Physeter catodon	sperm whale	300	X	
Eubalaena glacialis	right whale	29	X	
Balaenoptera borealis	sei whale	109	X	
Orcinus orca	killer whale	unk		
SMALL WHALES				
Tursiops truncatus	bottlenose dolphin	6,254		
Globicephala spp.	pilot whales	11,448		
Lagenorhynchus acutus	Atl. white-sided dolphin	24,287		
Phocoena	harbor porpoise	2,946		
Grampus griseus	grampus (Risso's) dolphin	10,220		
Delphinus delphis	saddleback dolphin	17,606		
Stenella spp.	spotted dolphin	22,376		
Stenella coeruleoalba	striped dolphin	unk		
Lagenorhynchus albirostris	white-beaked dolphin	unk		
Ziphius cavirostris	Cuvier's beaked dolphin	unk		
Stenella longirostris	spinner dolphin	unk		
Steno bredanensis	rough-toothed dolphin	unk		
Delphinapteras leucas	beluga	unk		
Mesoplodon spp.	beaked whales	unk		
TURTLES				
Caretta caretta	loggerhead turtle	4,017		X
Dermochelys coriacea	leatherback turtle	636	X	
Lepidochelys kempi	Kemp's ridley turtle	unk	X	
Chelonia mydas	green turtle	unk		X

Source: University of Rhode Island 1982.

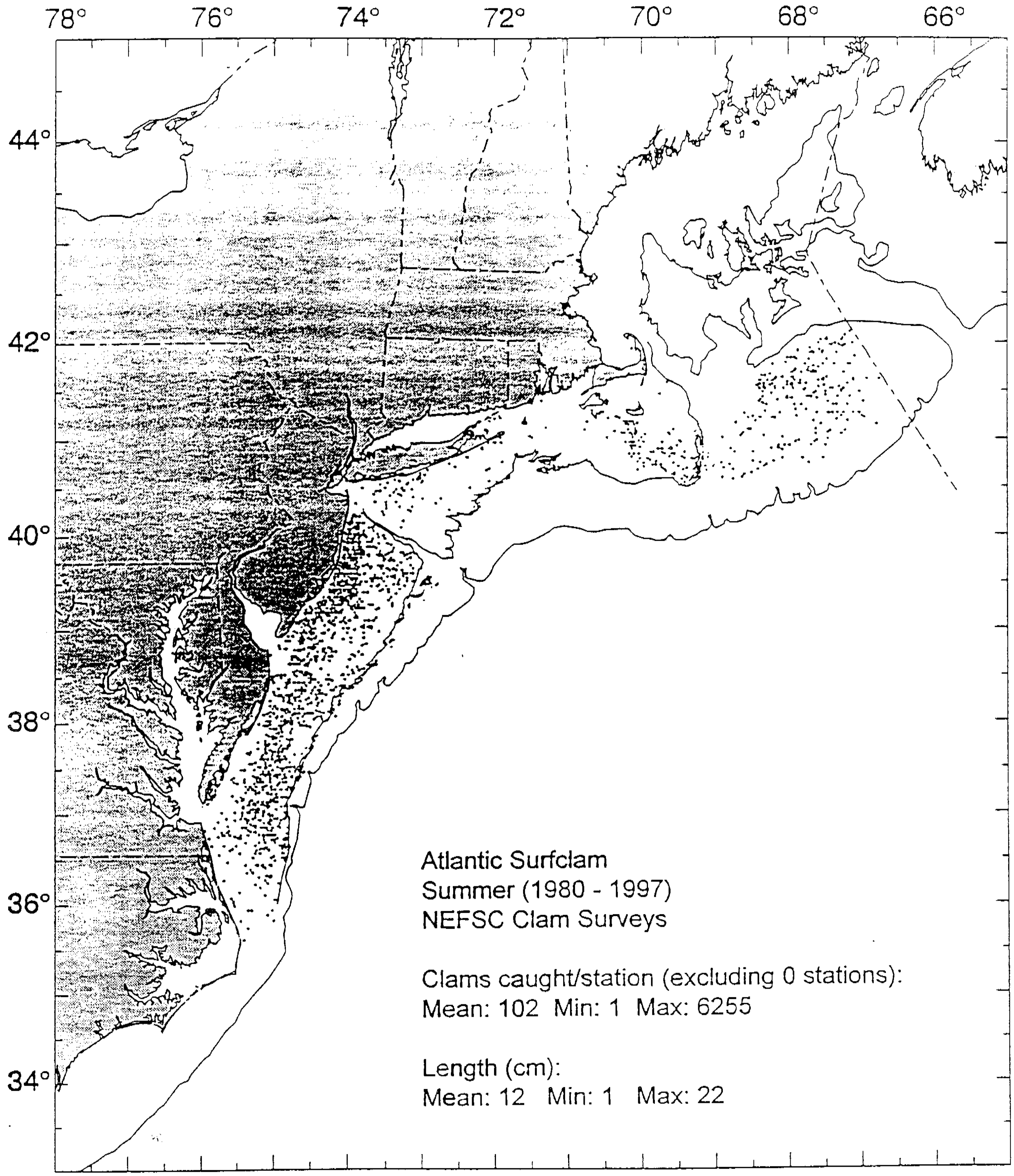


Figure 1. Distribution of Atlantic surfclams collected during NEFSC clam surveys in summer 1980-1997. Black dots represent stations where surfclams were caught.
Source: Weissberger et al. 1998a-b.

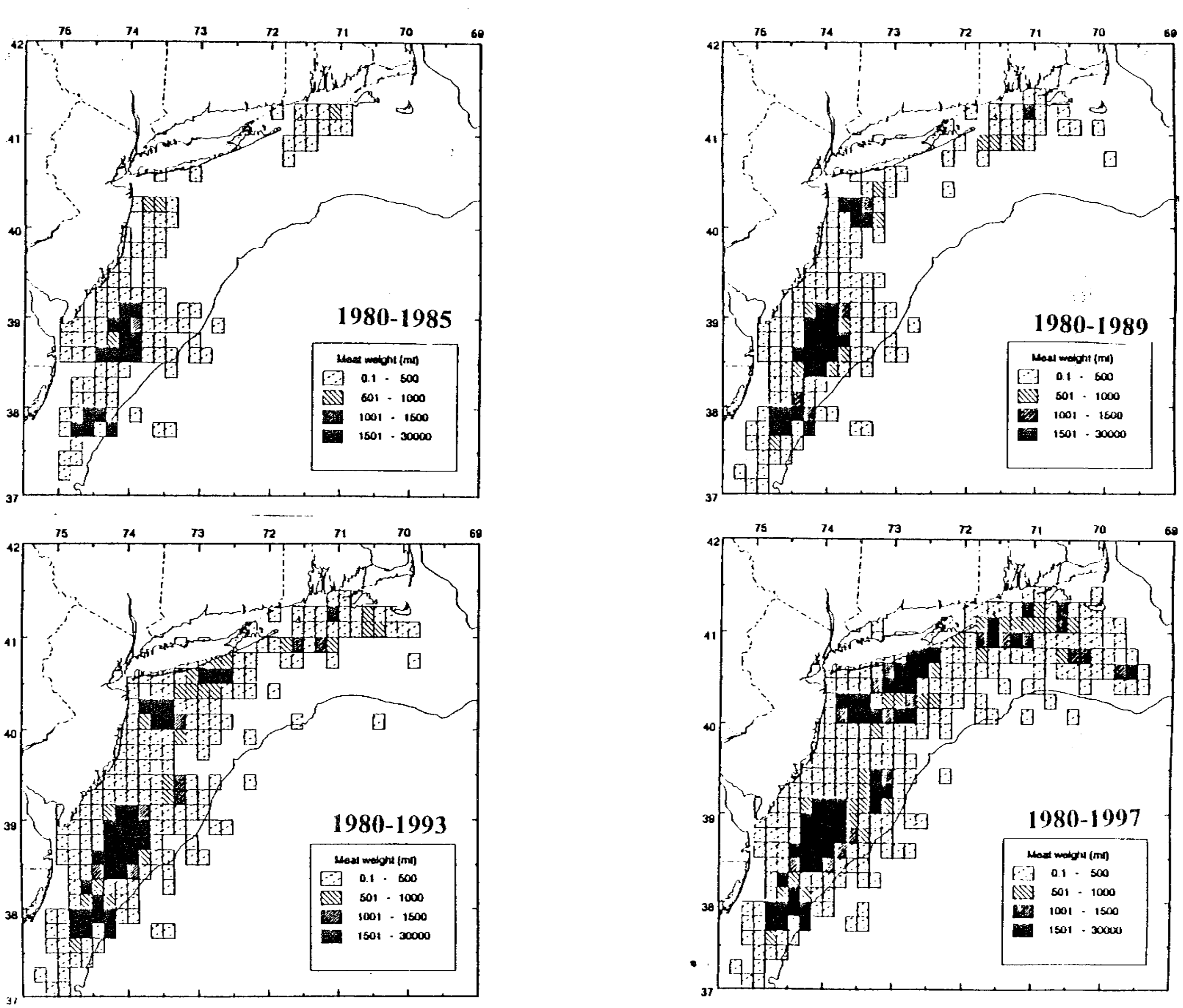


Figure 2. Cumulative landings of ocean quahogs by 10 minute squares for various time periods.
Source: NEFSC 1998b.

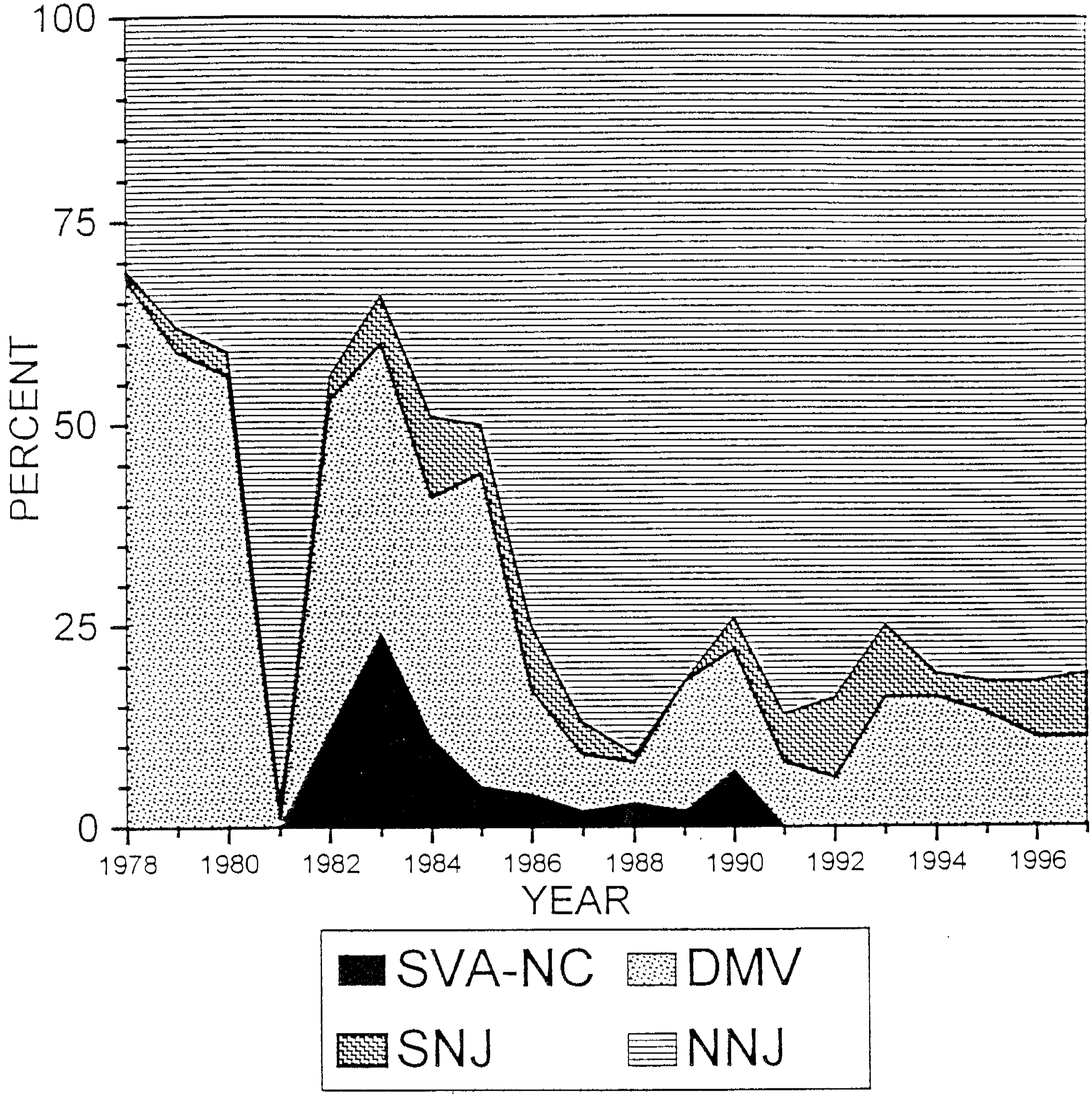


Figure 3. Proportion of surfclam landings in the Mid-Atlantic region, by area and year, 1978-1997. Landings for 1997 were estimated from logbook data available on 13 September 1997. Source: NEFSC 1998a.

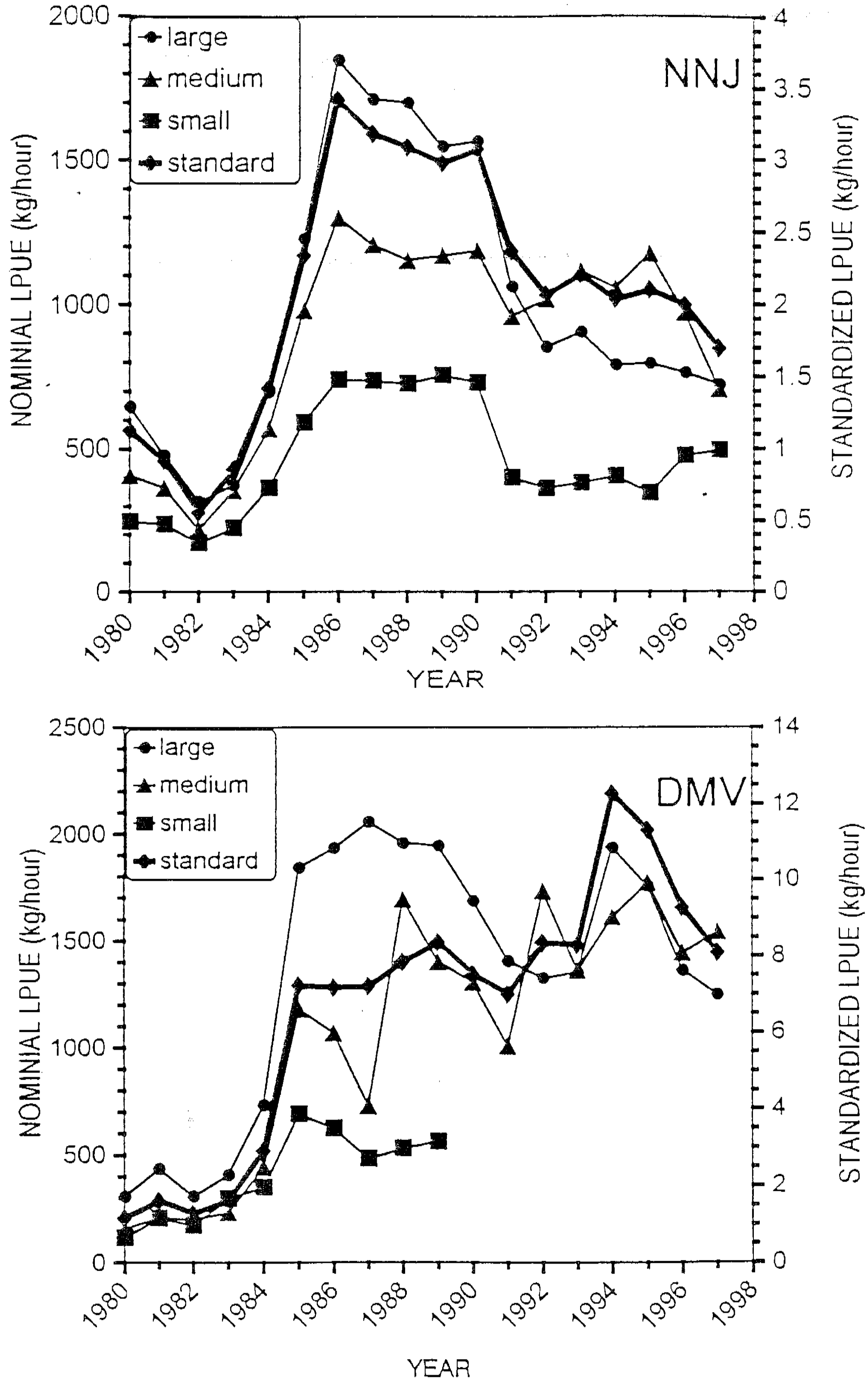
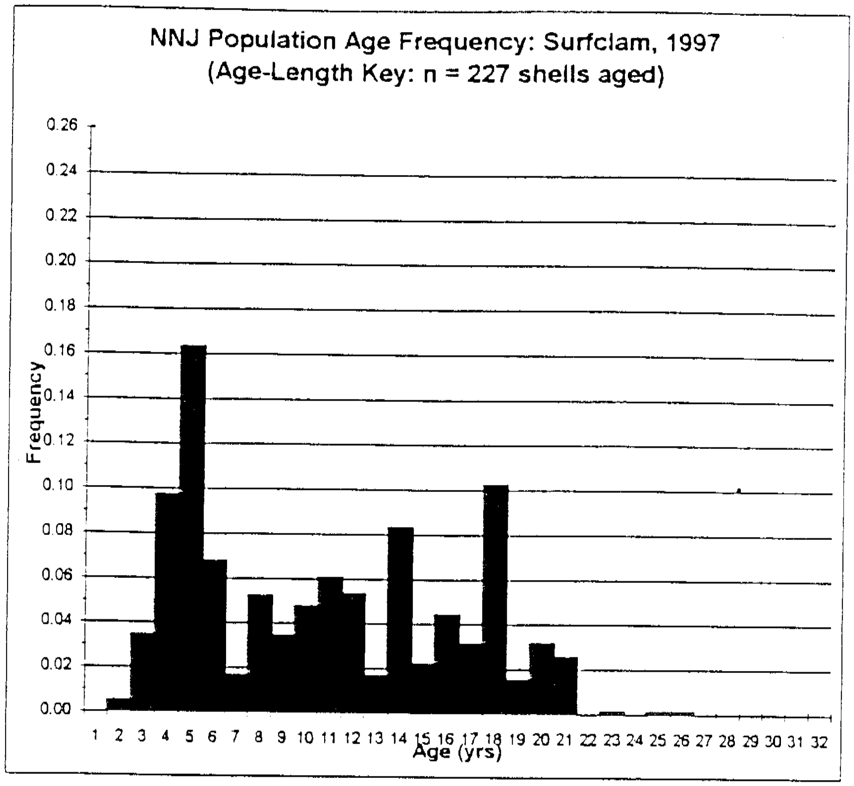


Figure 4. Nominal surfclam LPUEs by year for two regions (Delmarva and Norther New Jersey) and three vessel classes (small, medium, and large). Also shown are standardized LPUEs from GLM analyses.
Note: 1 kg = 2.205 pounds
Source: NEFSC 1998a.



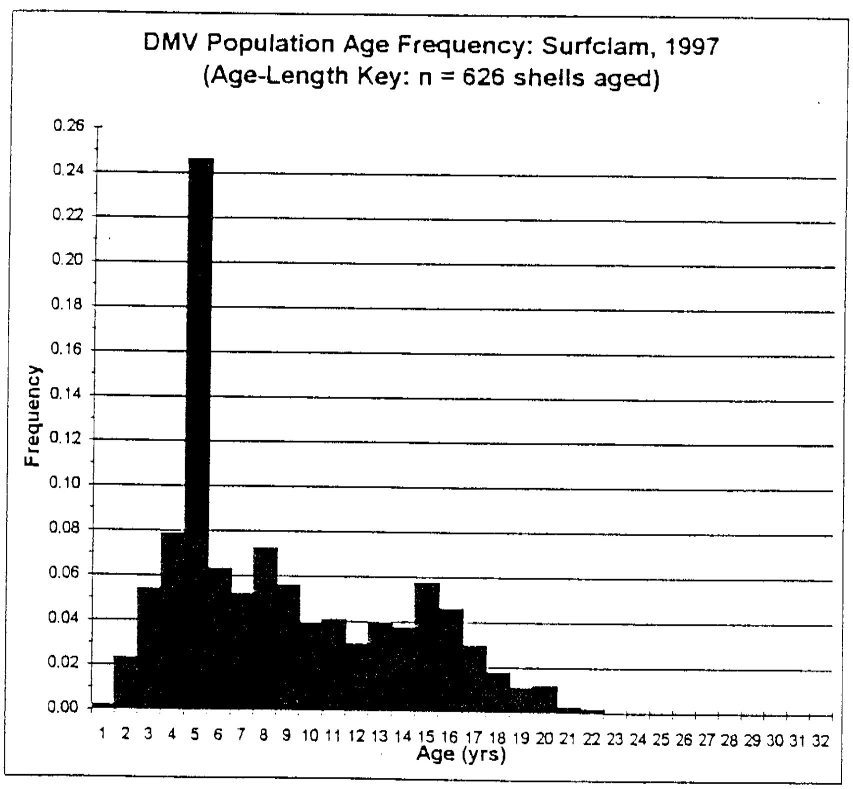


Figure 5. Age frequency distribtion in 1997 for surfclams of N. New Jersey and Delmarva. Age/length keys were applied to the size frequency distributions for each region. Sourc: NEFSC 1998a.

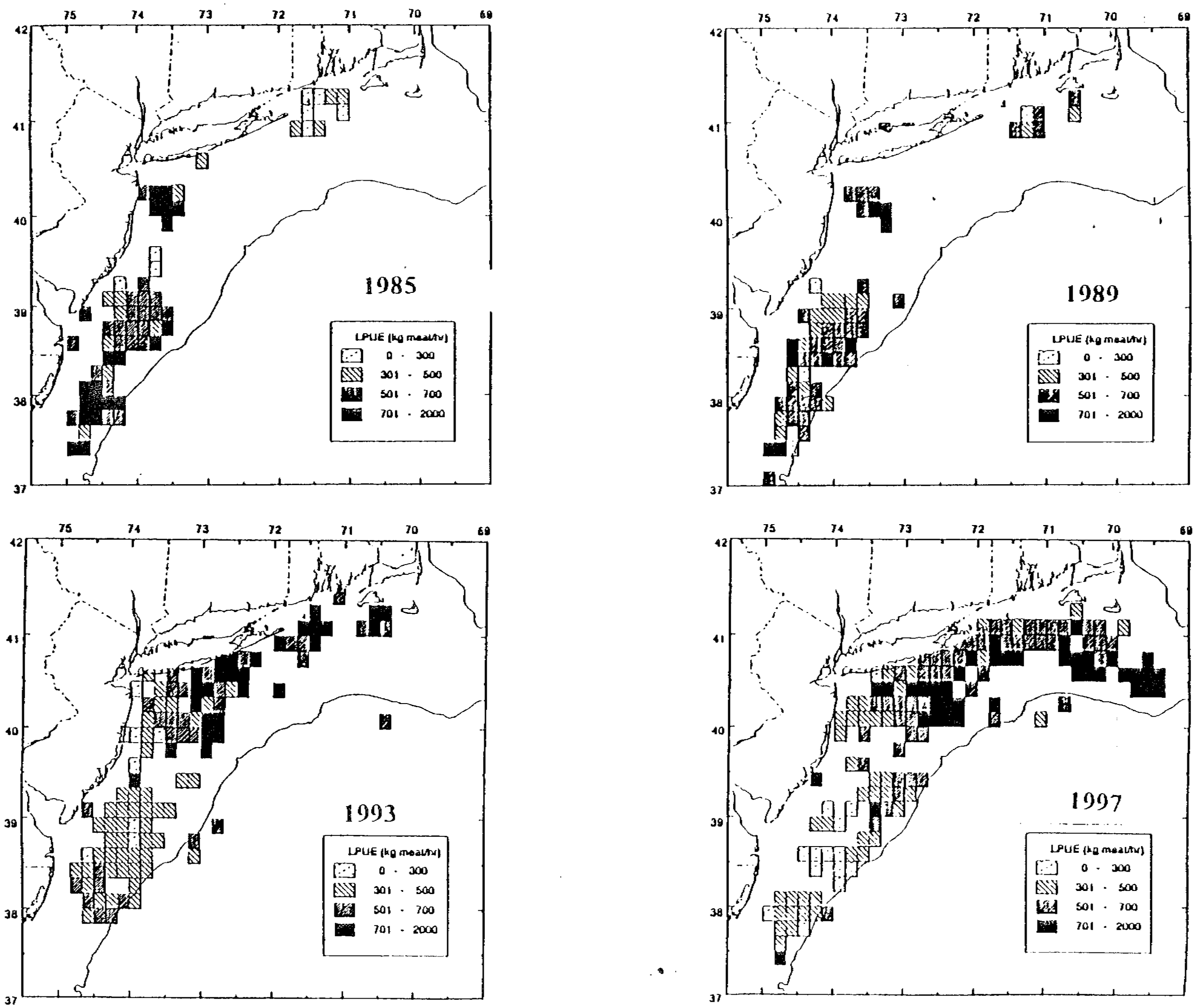


Figure 6. Maps of landings-per-unit effort, LPUE (kg meat/hr fished) of ocean quahogs by 10 minute squares for 1985, 1989, 1993, and 1997.
Note: 1 kg = 2.205 pounds
Source: NEFSC 1998b.

LPUE vs Fishing Year for All Vessel Classes

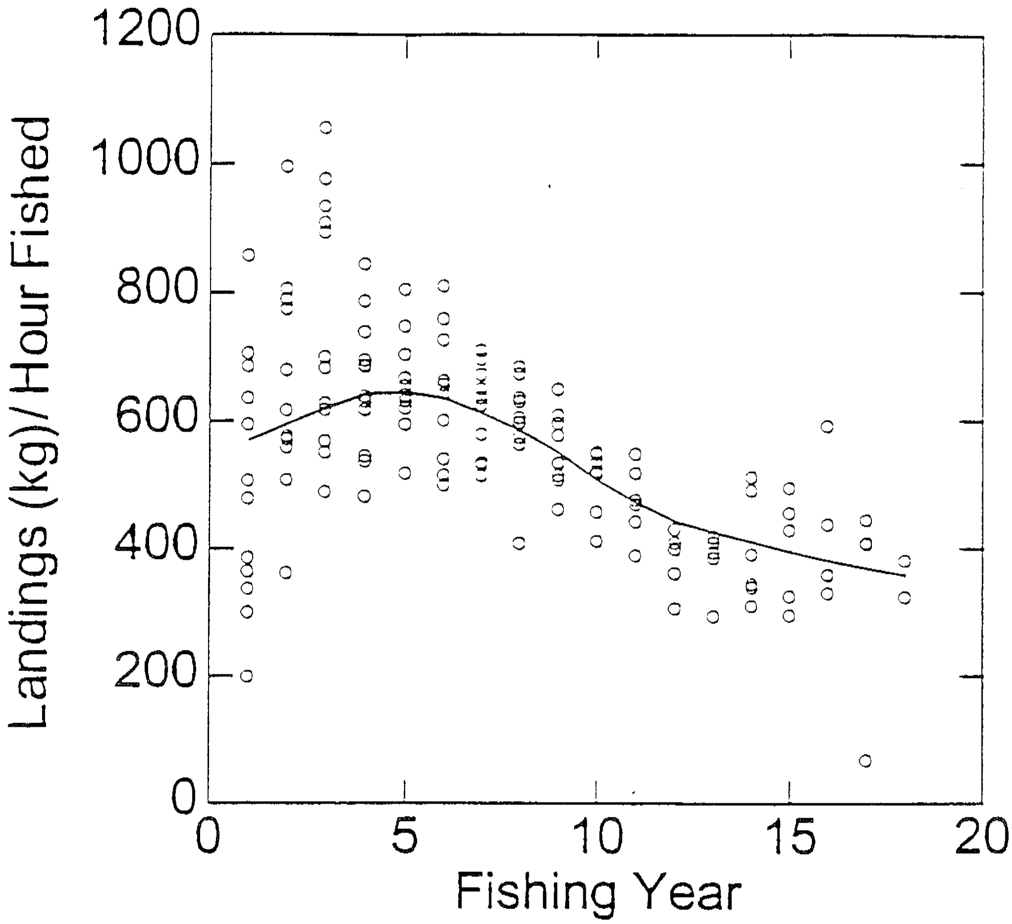


Figure 7. Ocean quahog catch rate within heavily fished 10 minute squares in relation to years of exploitation.
Note: 1 kg = 2.205 pounds
Source: USDC 1998b.

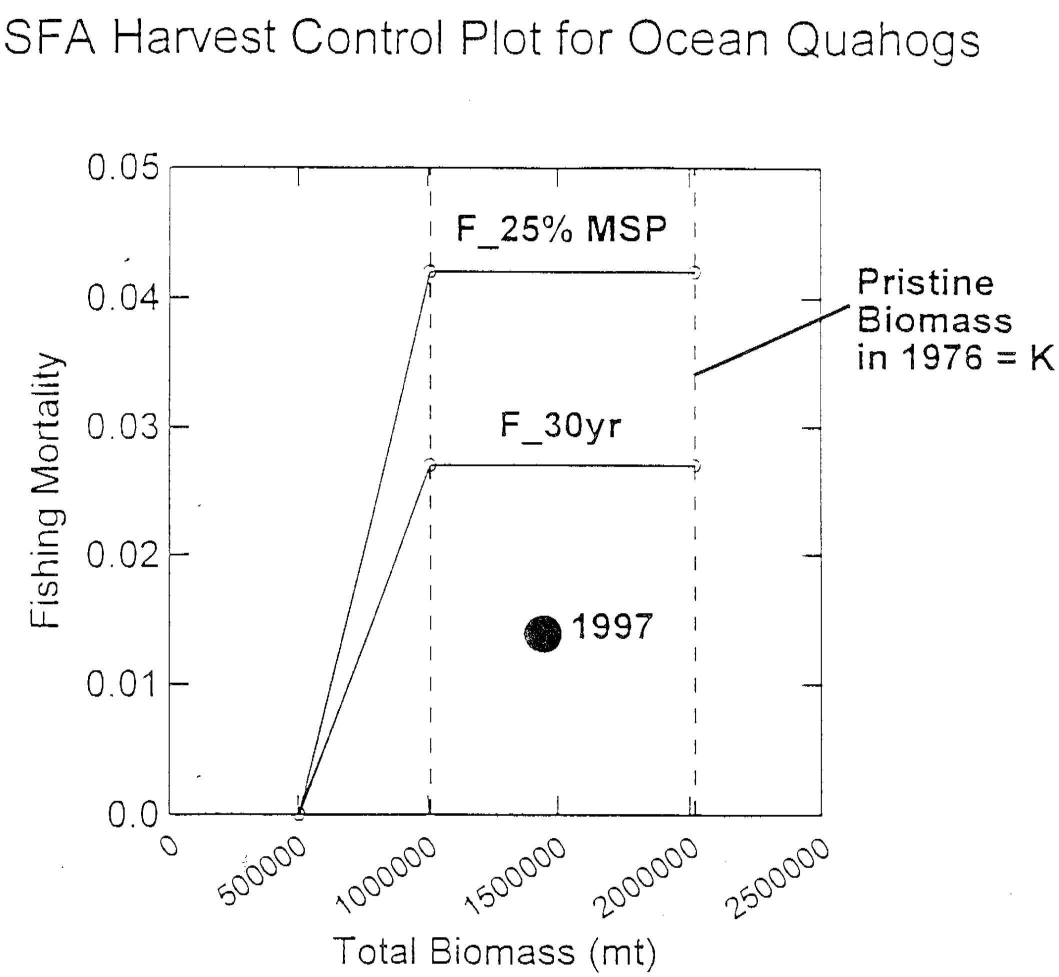


Figure 8. Estimated fishing mortality rate and total biomass of ocean quahogs in 1997 (filled circle) in relation to fishing mortality biomass thresholds and targets. Pristine biomass (K) in 1976 (right dashed line) is estimated via back-calculation method using 1997 population estimate and cumulative harvests. B_{msy} (left dashed line) is estimated as 1/2K. Horizontal lines represent two alternative fishing mortality thresholds. Sloped lines represent implied fishing mortality rates for population biomass levels between 1/4K and 1/2K.
Note: 1 metric ton = 2205 pounds
Source: NEFSC 1998b.

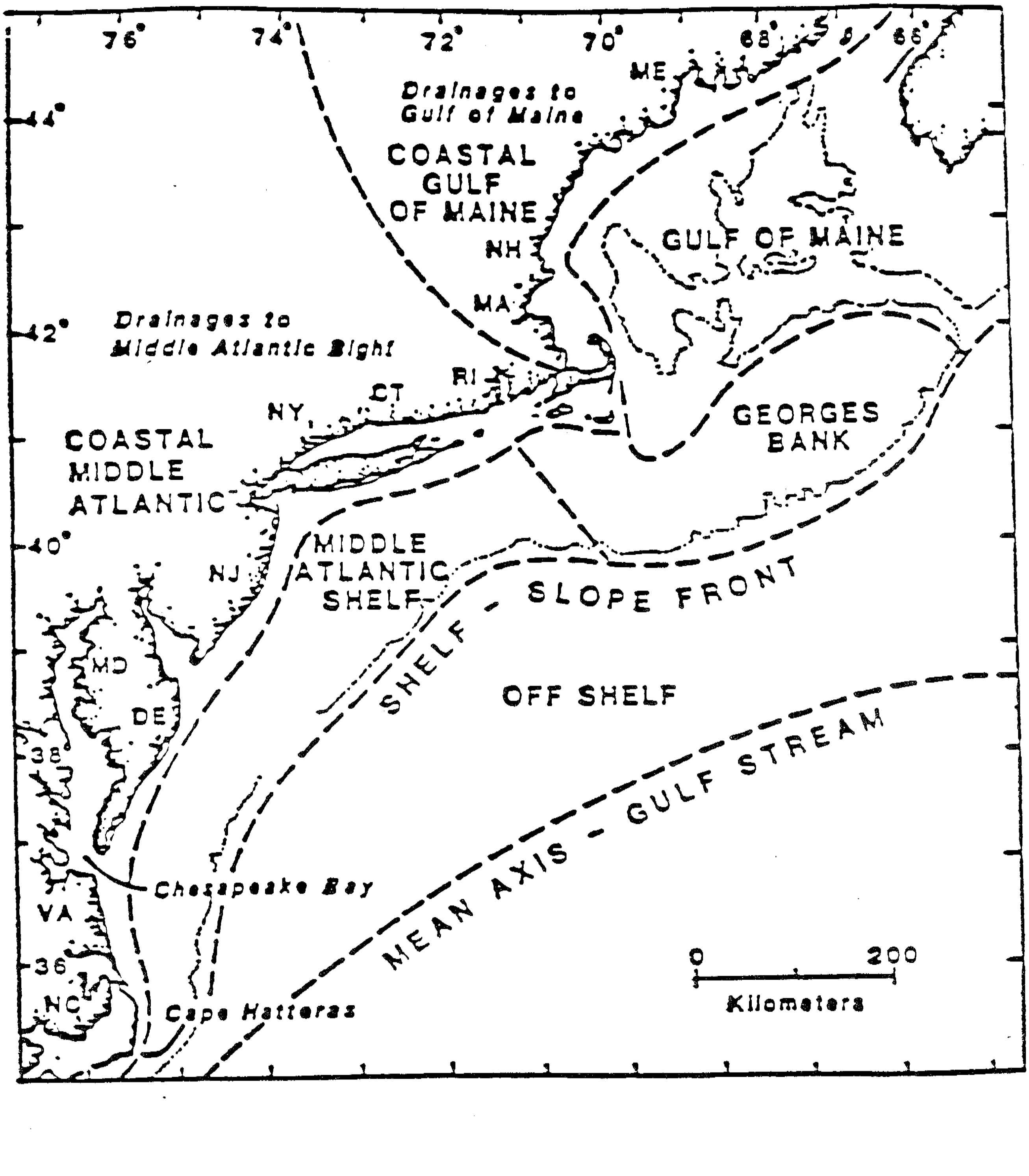


Figure 9. Northeast Regional Action Plan (RAP) Water Management Units.
Source: USDC 1985a.

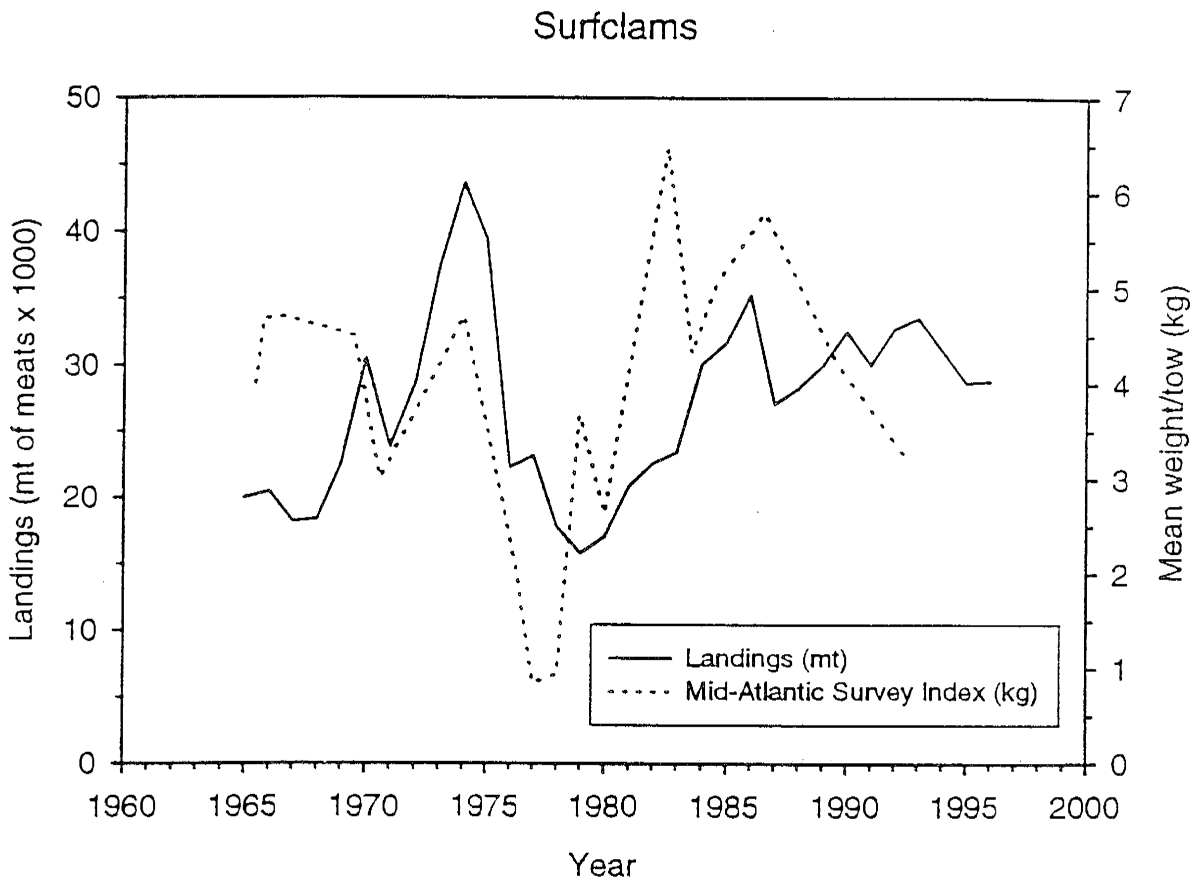


Figure 10. Commercial landings and survey indices of Atlantic surfclams in the Middle Atlantic region.
Note: 1,000 metric tons = 2.205 million pounds
Source: Weissberger et al. 1998a-b.

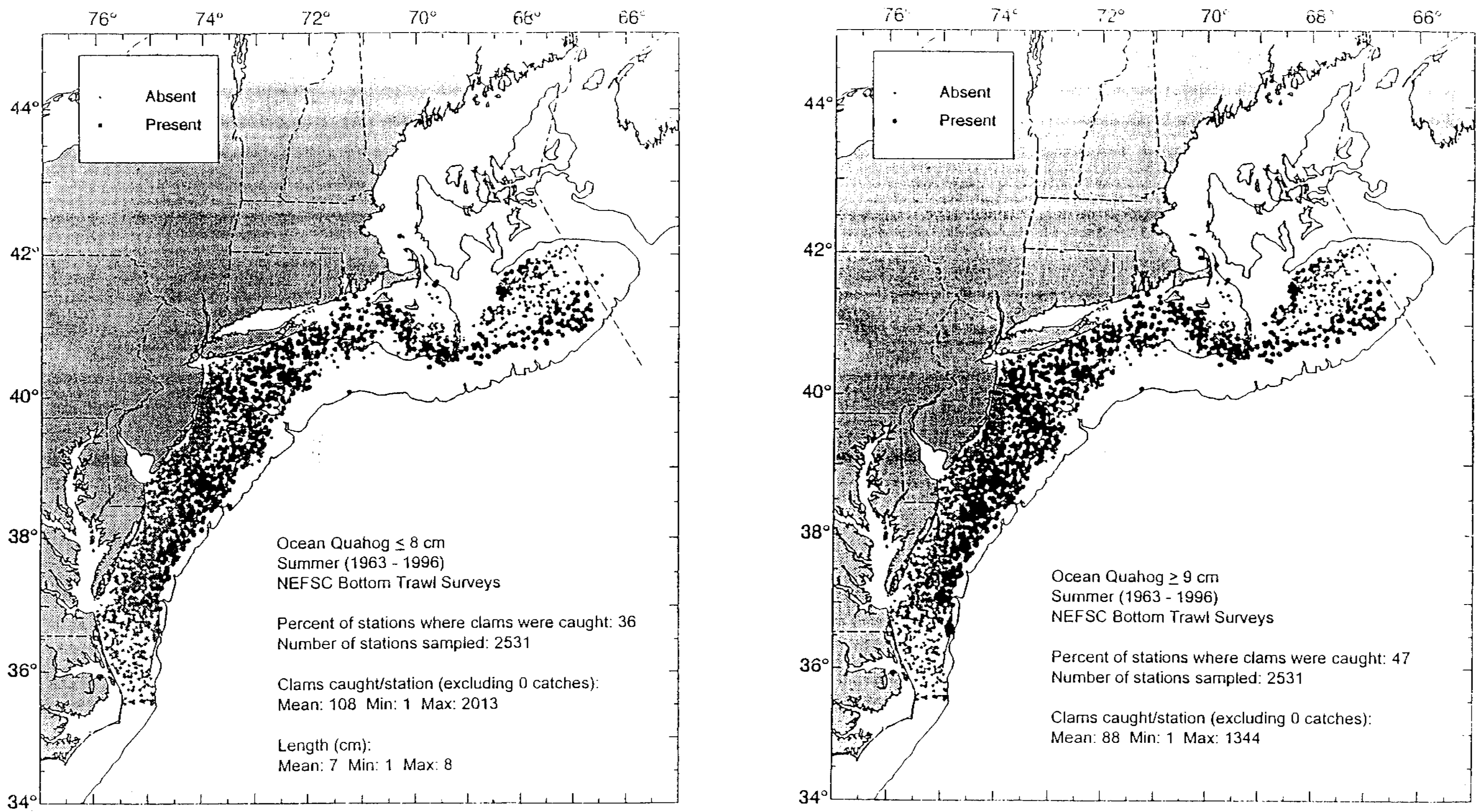


Figure 11. Distribution of ocean quahog juveniles (a) and adults (b) collected during NEFSC summer bottom trawl surveys from 1963-1996. Black dots represent stations where ocean quahogs were caught, and smaller grey dots represent stations where no quahogs were caught.
Note: 1 in. = 2.54 cm
Source: Weissberger et al. 1998b.

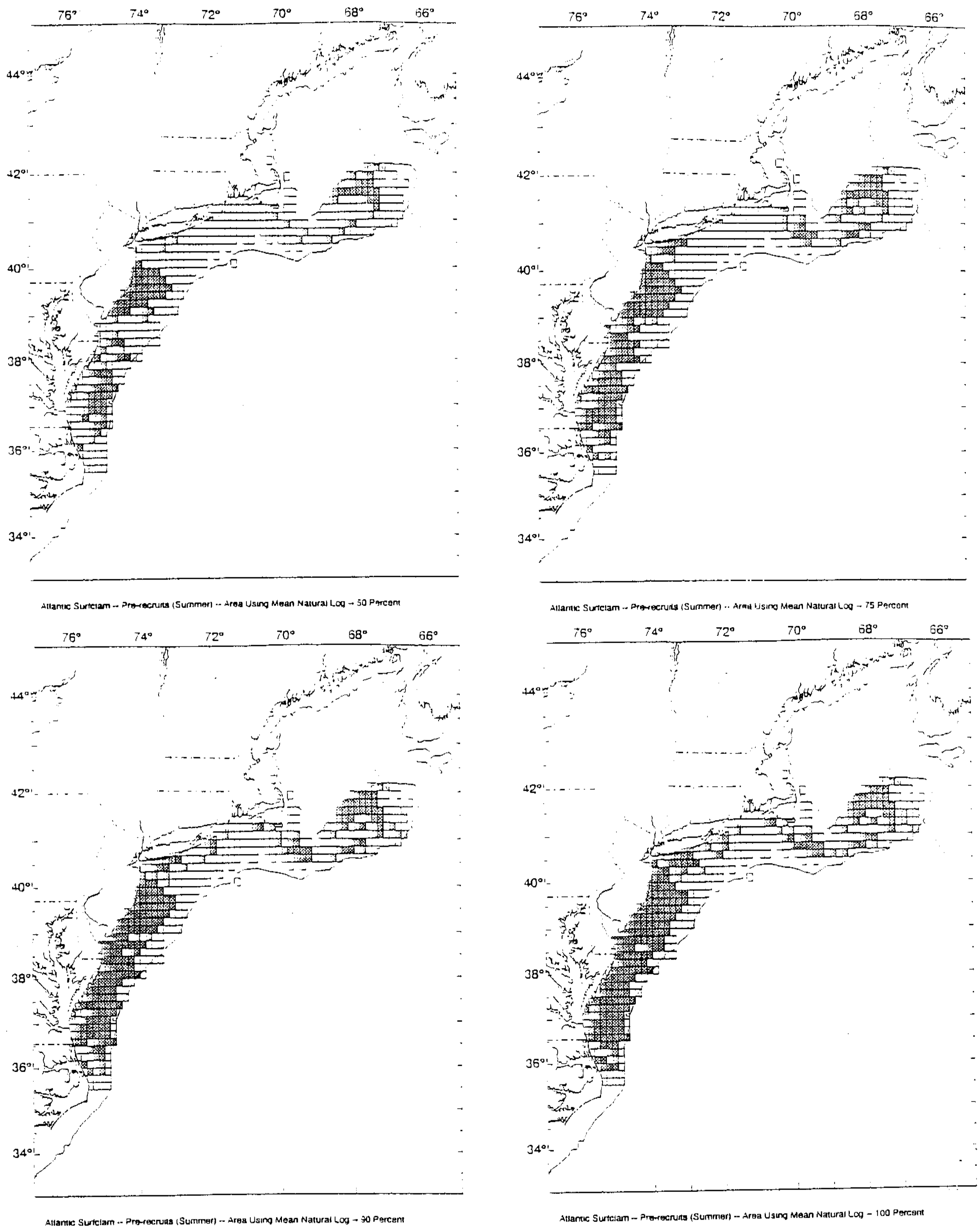


Figure 12a. Four options for designating EFH for surfclam pre-recruits under Alternative 5, the preferred alternative: 1) the top 50% of the area, 2) the top 75% of the area, 3) the top 90% of the area, and 4) the top 100% of the area where surfclam pre-recruits were found in the NEFSC dredge survey.
Source: Cross per. comm.

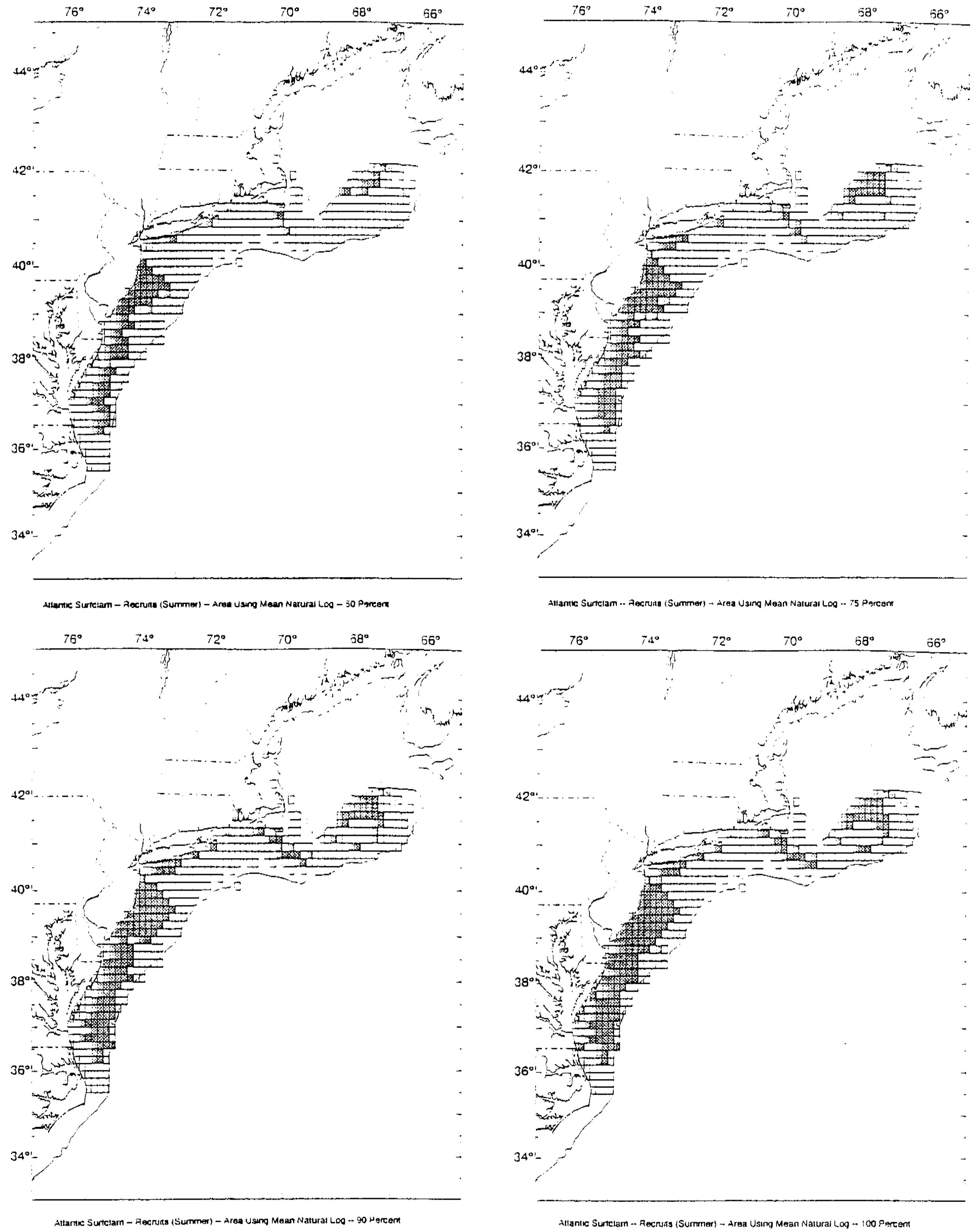
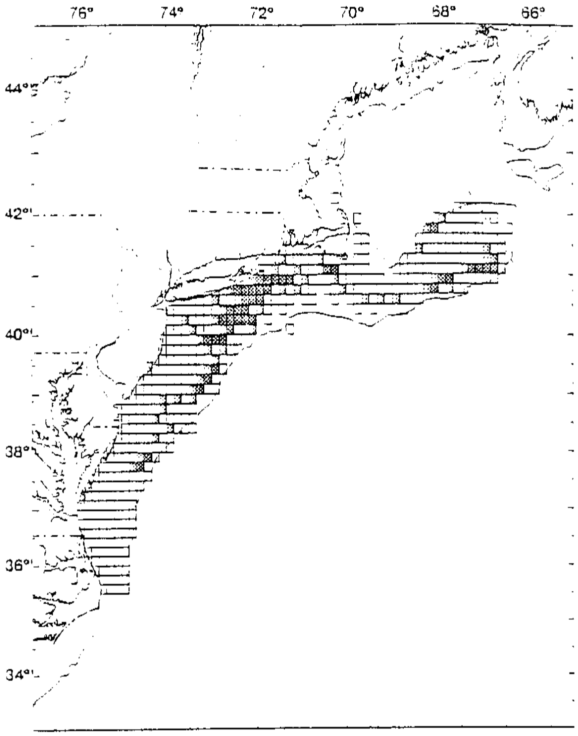
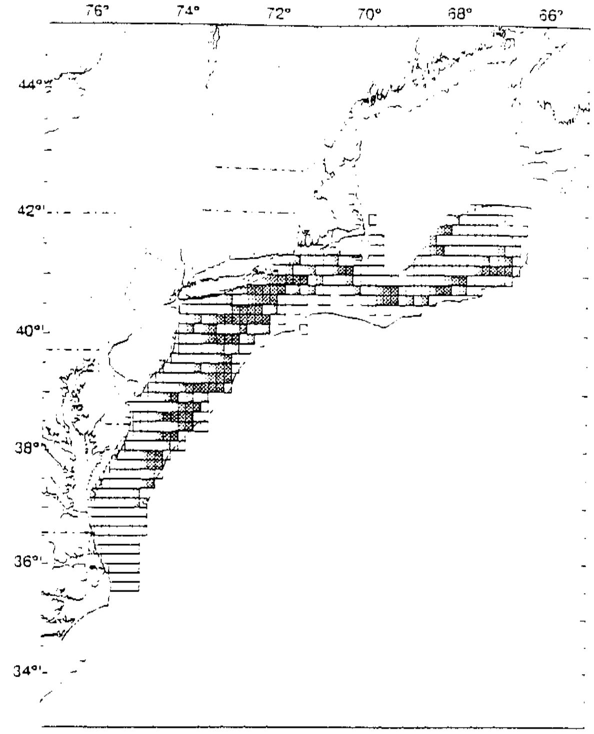


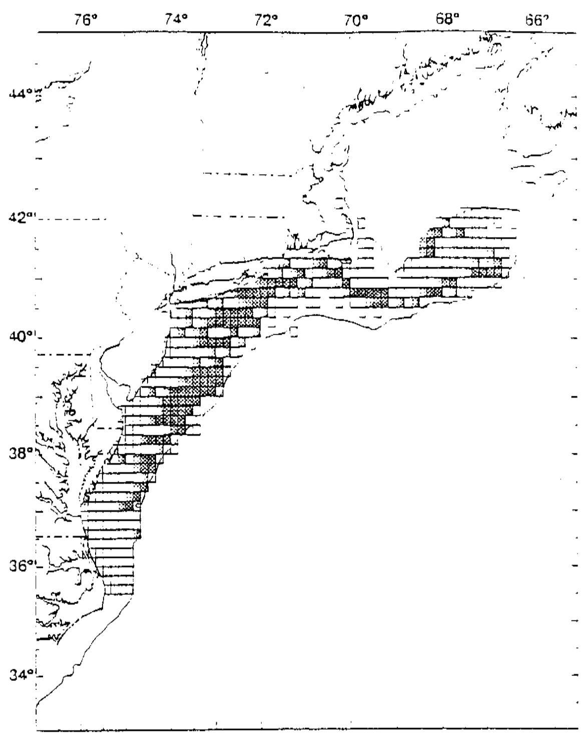
Figure 12b. Four options for designating EFH for surfclam recruits under Alternative 5, the preferred alternative: 1) the top 50% of the area, 2) the top 75% of the area, 3) the top 90% of the area, and 4) the top 100% of the area where surfclam recruits were found in the NEFSC dredge survey.
Source: Cross pers. comm.



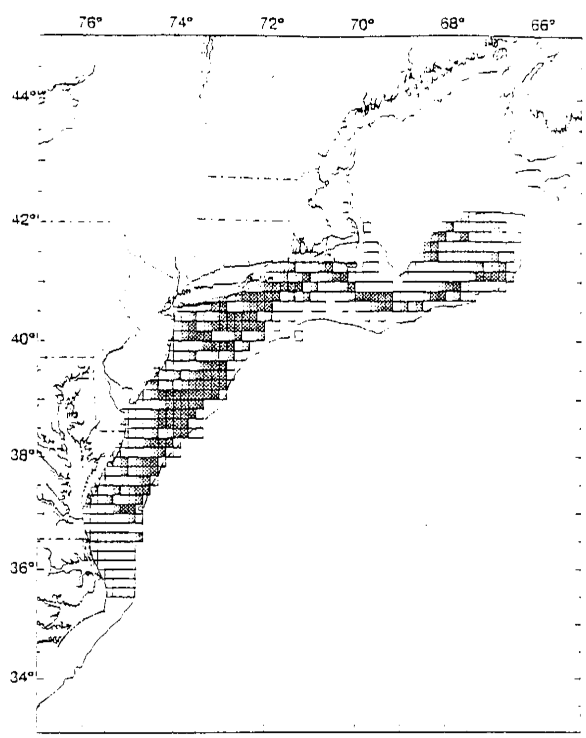
Ocean Quahog -- Pre-recruits (Summer) -- Area Using Mean Natural Log -- 50 Percent



Ocean Quahog -- Pre-recruits (Summer) -- Area Using Mean Natural Log -- 75 Percent



Ocean Quahog -- Pre-recruits (Summer) -- Area Using Mean Natural Log -- 90 Percent



Ocean Quahog -- Pre-recruits (Summer) -- Area Using Mean Natural Log -- 100 Percent

Figure 13a. Four options for designating EFH for ocean quahog pre-recruits under Alternative 5, the preferred alternative: 1) the top 50% of the area, 2) the top 75% of the area, 3) the top 90% of the area, and 4) the top 100% of the area where ocean quahog pre-recruits were found in the NEFSC dredge survey.
Source: Cross pers. comm.

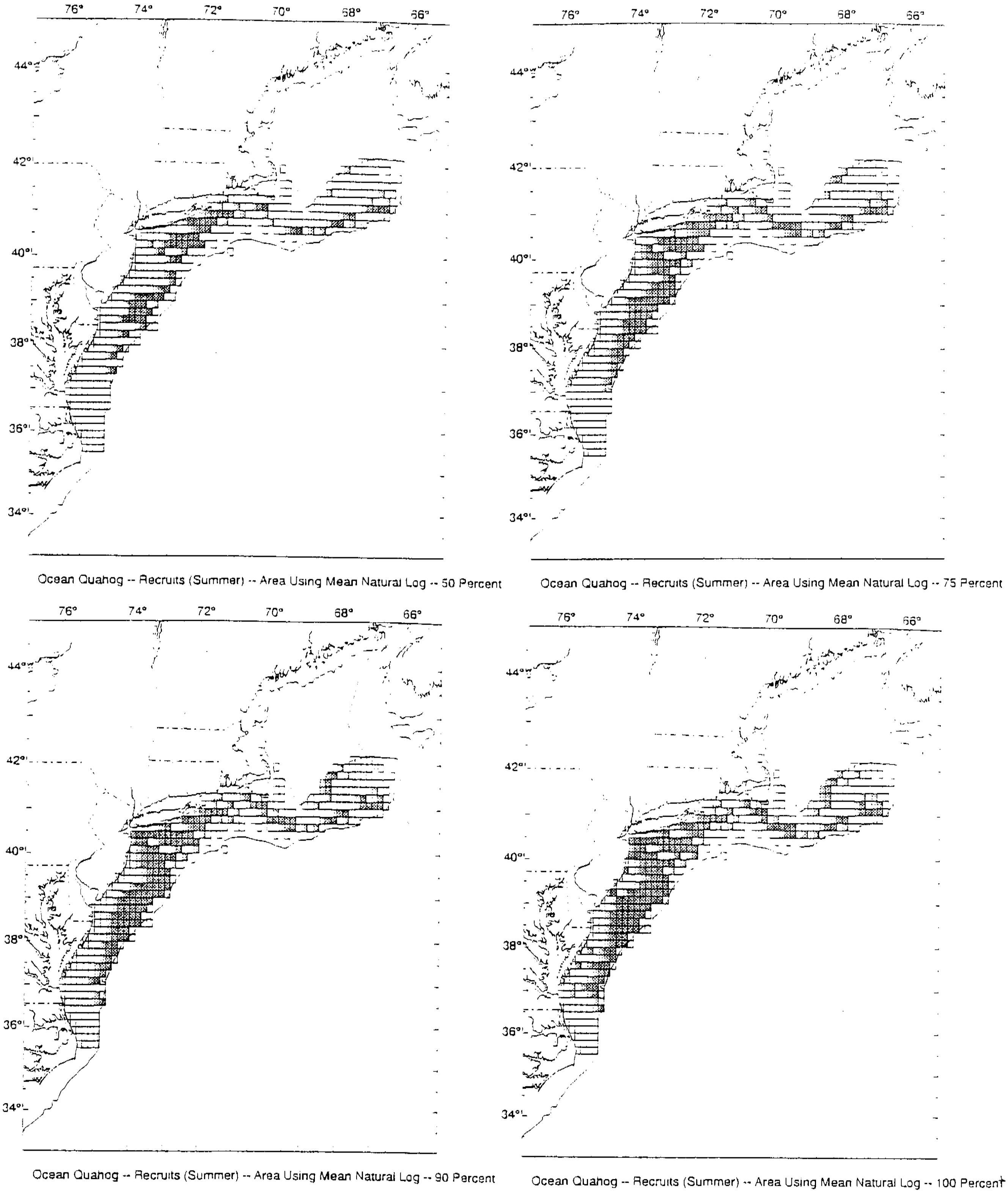


Figure 13b. Four options for designating EFH for ocean quahog recruits under Alternative 5, the preferred alternative: 1) the top 50% of the area, 2) the top 75% of the area, 3) the top 90% of the area, and 4) the top 100% of the area where ocean quahog recruits were found in the NEFSC dredge survey.
Source: Cross pers. comm.

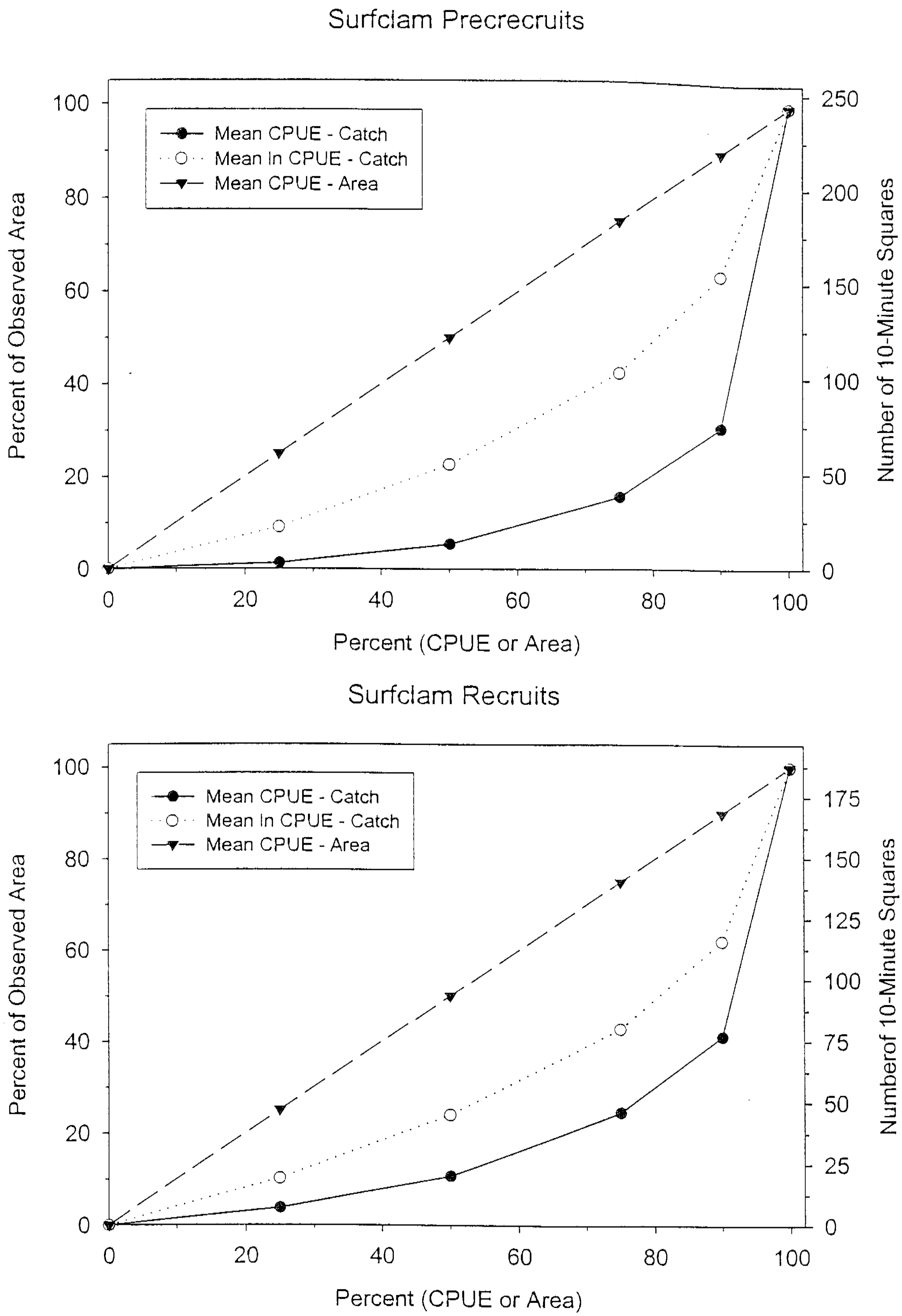


Figure 14. Graphical representation of percent area and numbers of 10 minute squares encompassed in the a) area analysis, b) logged CPUE analysis, and c) CPUE of surfclam pre-recruits and recruits.
Source: Cross pers. comm.

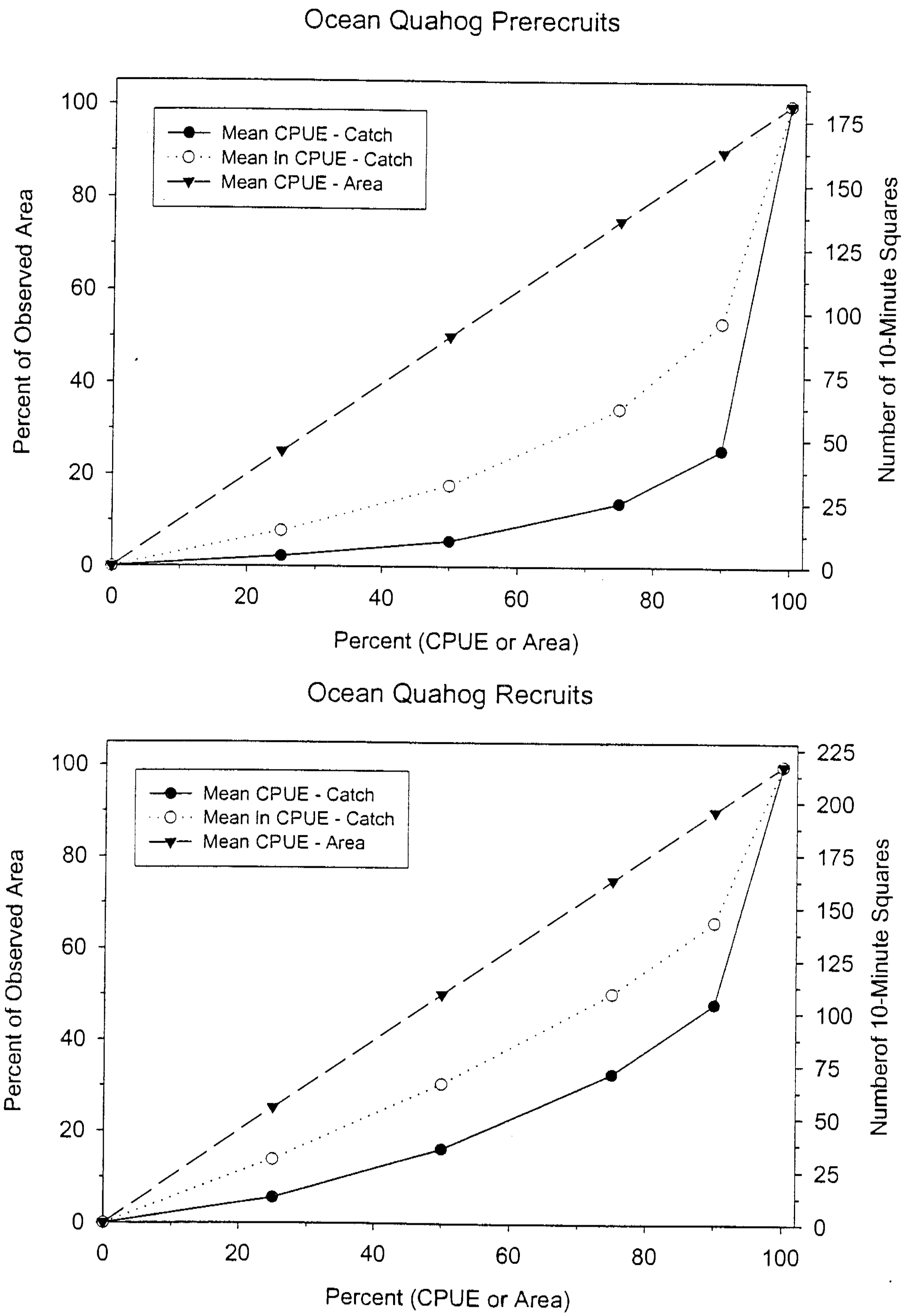
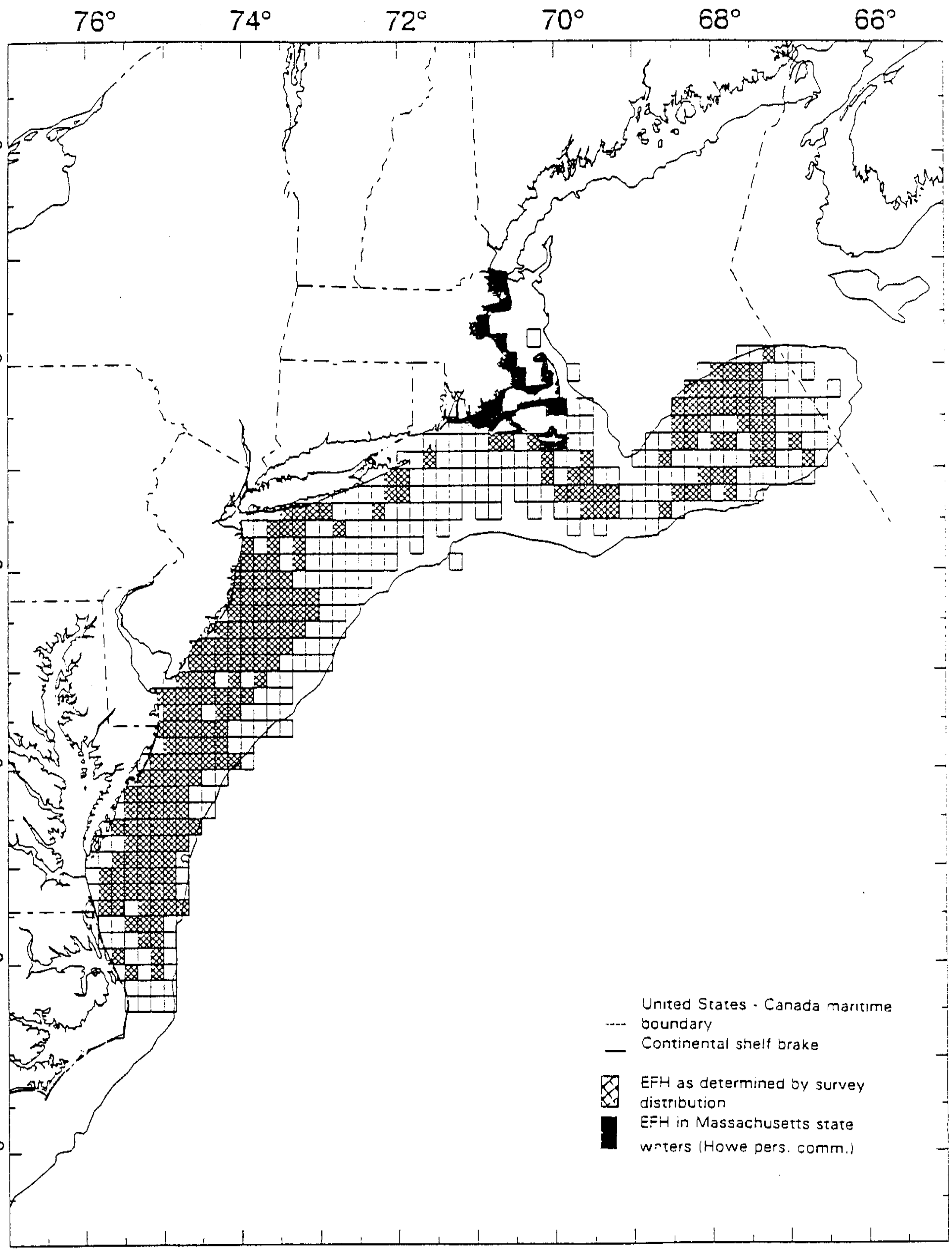
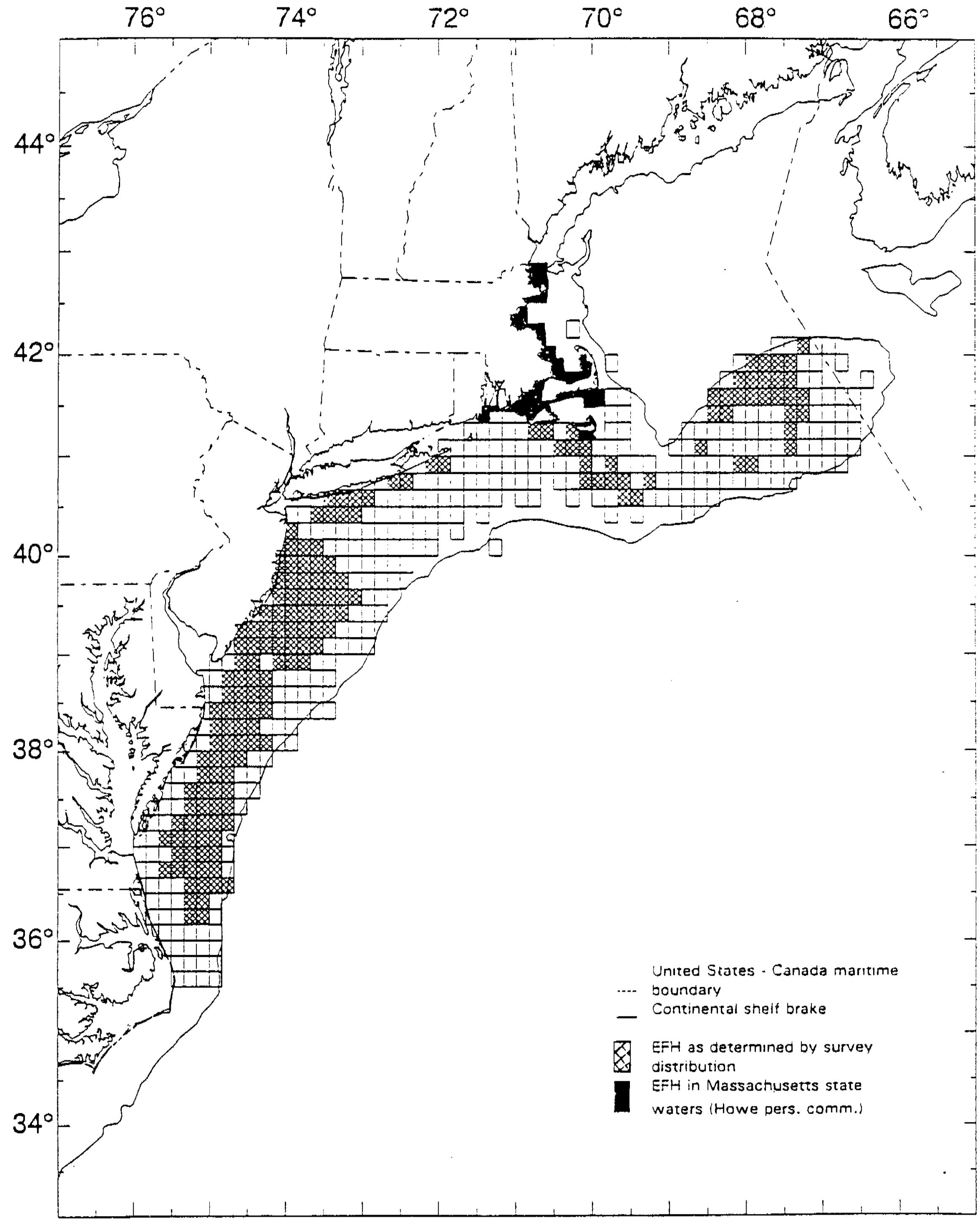


Figure 15. Graphical representation of percent area and numbers of 10 minute squares encompassed in the a) area analysis, b) logged CPUE analysis, and c) CPUE of ocean quahog pre-recruits and recruits.
Source: Cross pers. comm.



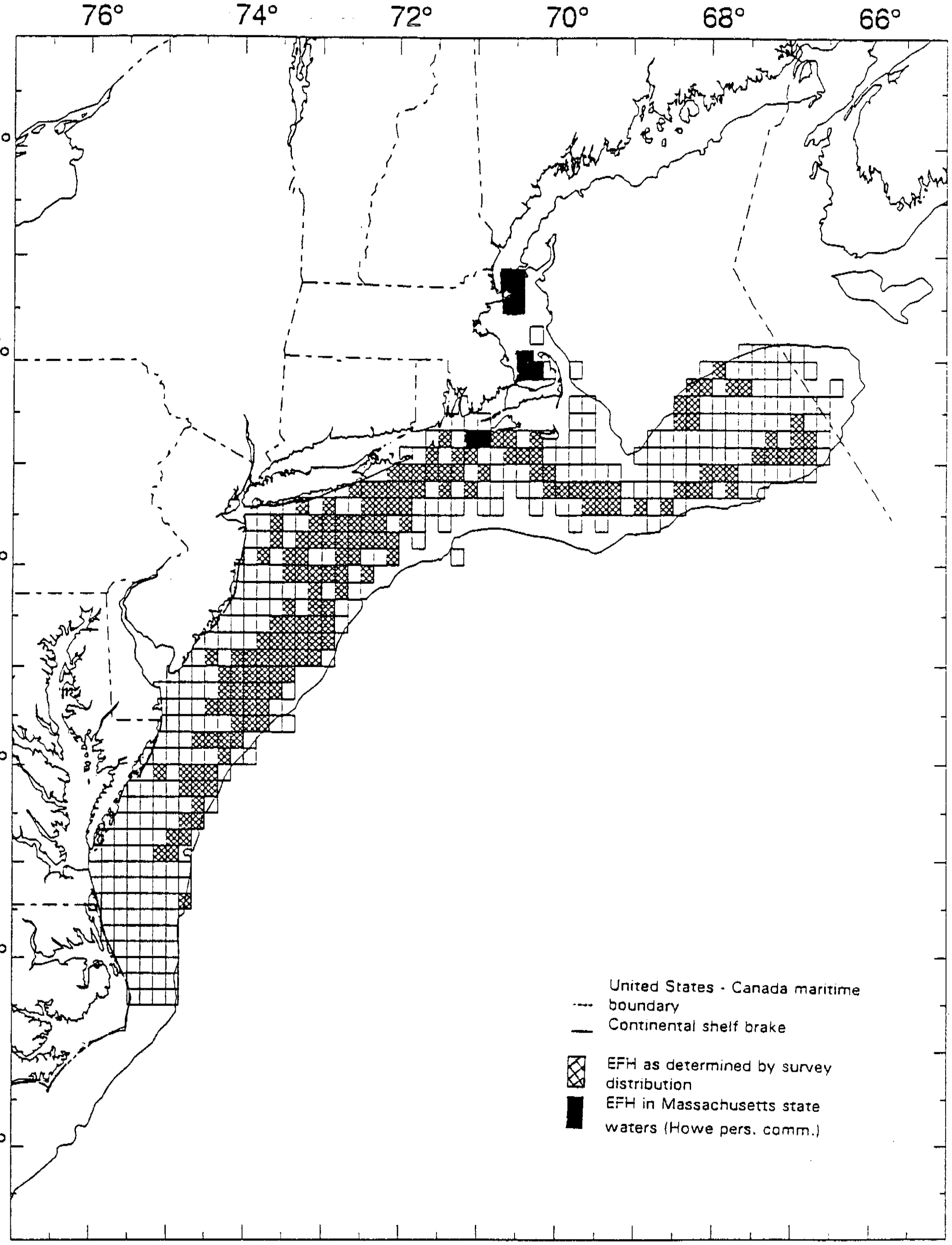
Atlantic Surfclam -- Pre-recruits (Summer) -- Area Using Mean Natural Log -- 90 Percent

Figure 16a. EFH for juvenile surfclams, areas which encompass the top 90% of the areas where surfclams were collected in the NEFSC dredge survey.



Atlantic Surfclam -- Recruits (Summer) -- Area Using Mean Natural Log -- 90 Percent

Figure 16b. EFH for adult surfclams, areas which encompass the top 90% of the areas where surfclams were collected in the NEFSC dredge survey.



Ocean Quahog -- Pre-recruits (Summer) -- Area Using Mean Natural Log -- 90 Percent

Figure 17a. EFH for juvenile ocean quahogs, areas which encompass the top 90% of the areas where ocean quahogs were collected in the NEFSC dredge survey.

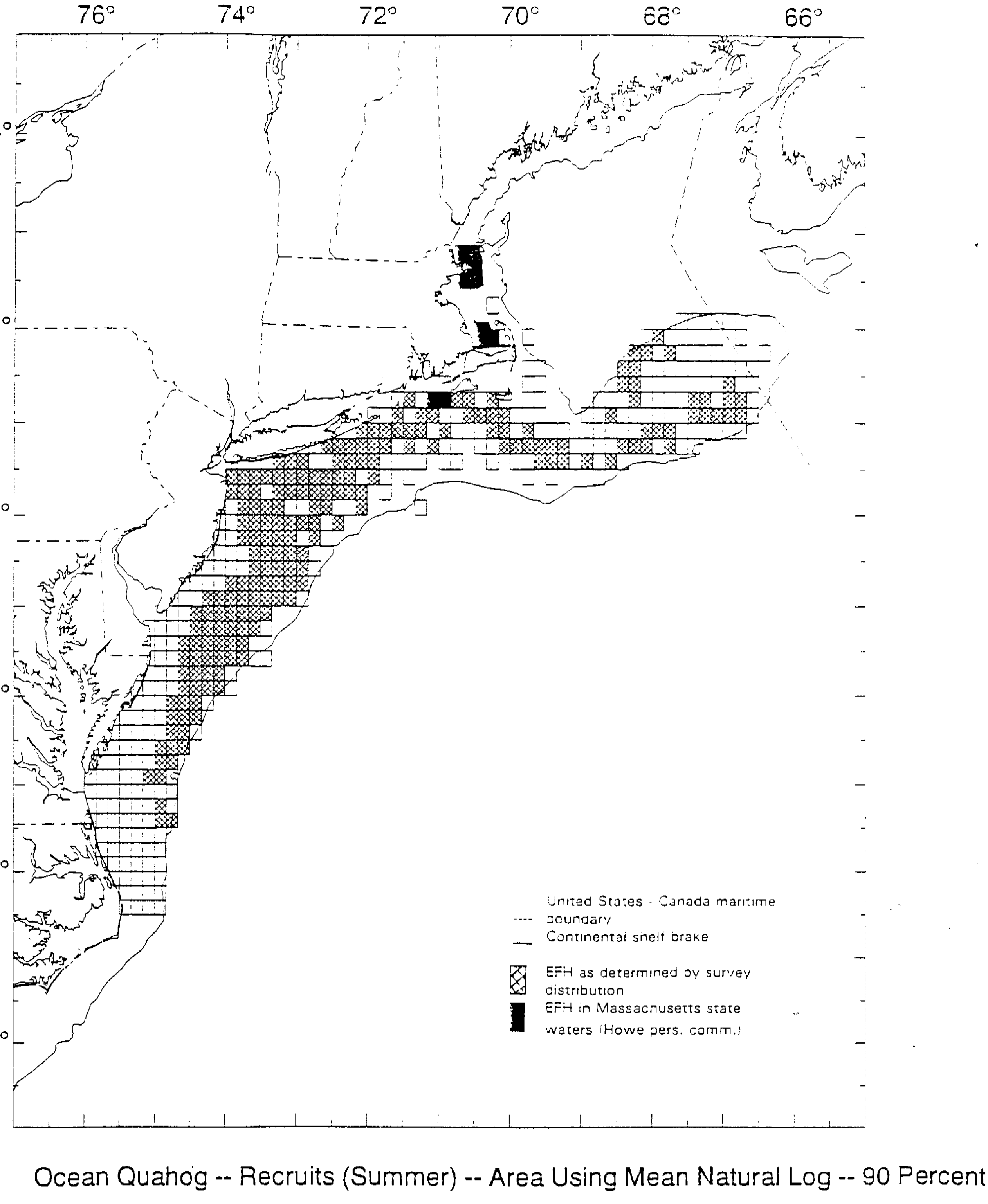


Figure 17b. EFH for adult ocean quahogs, areas which encompass the top 90% of the areas where ocean quahogs were collected in the NEFSC dredge survey.

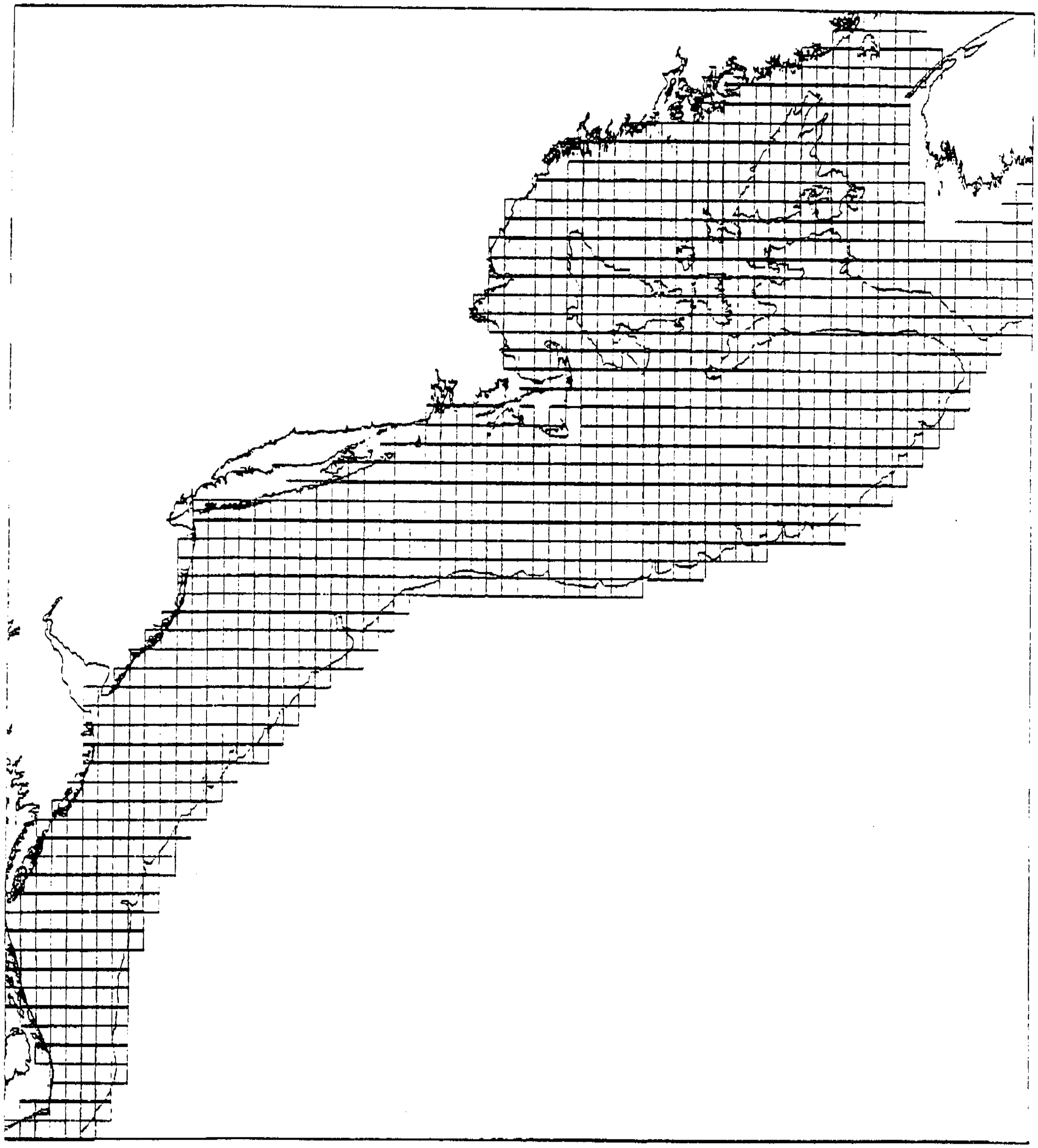


Figure 18. Blank 10 minute grid north of Cape Hatteras, NC for input by the public on surfclam and ocean quahog EFH.

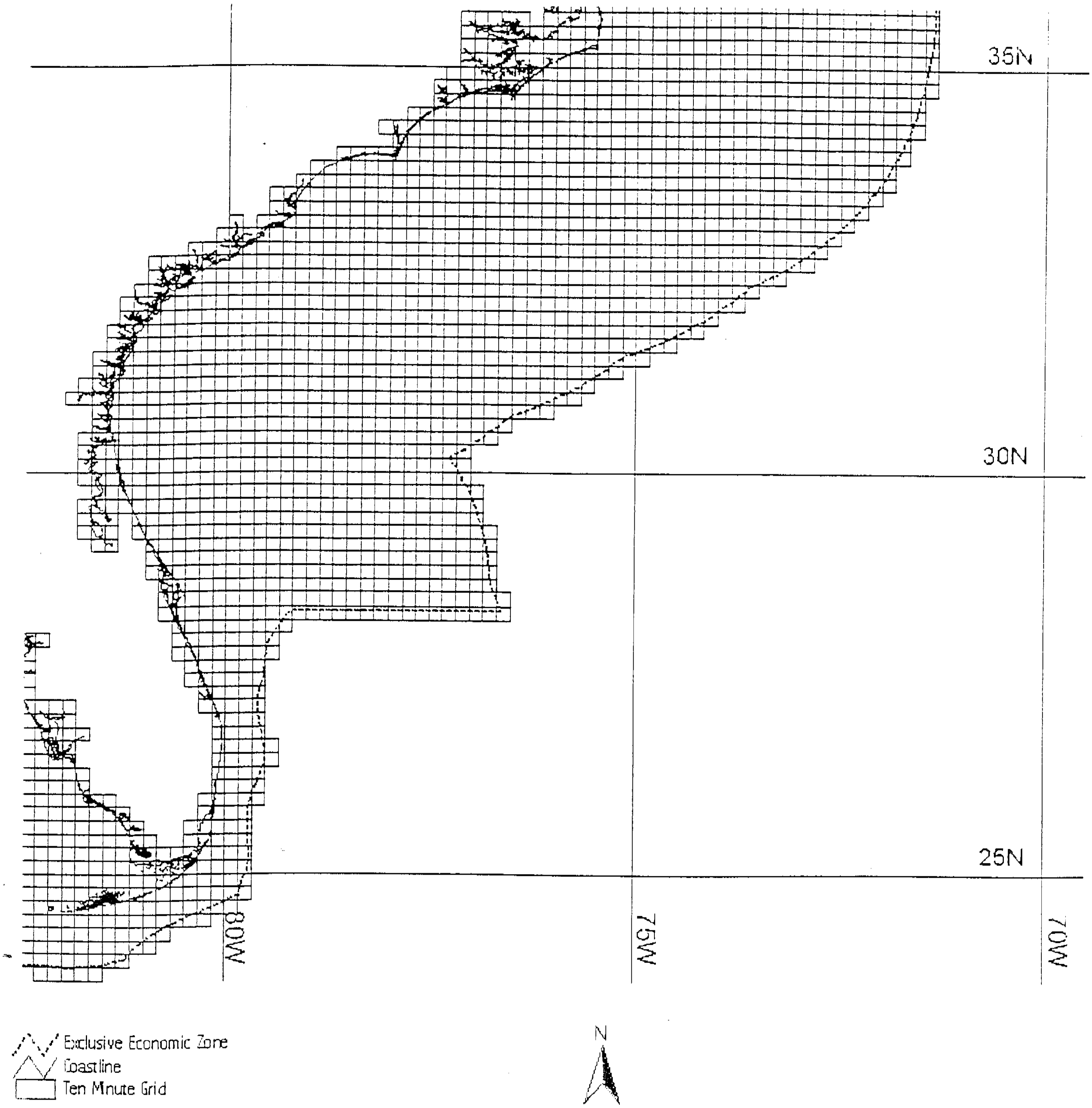


Figure 19. Blank 10 minute grid south of Cape Hatteras, NC for input by the public on surfclam and ocean quahog EFH.

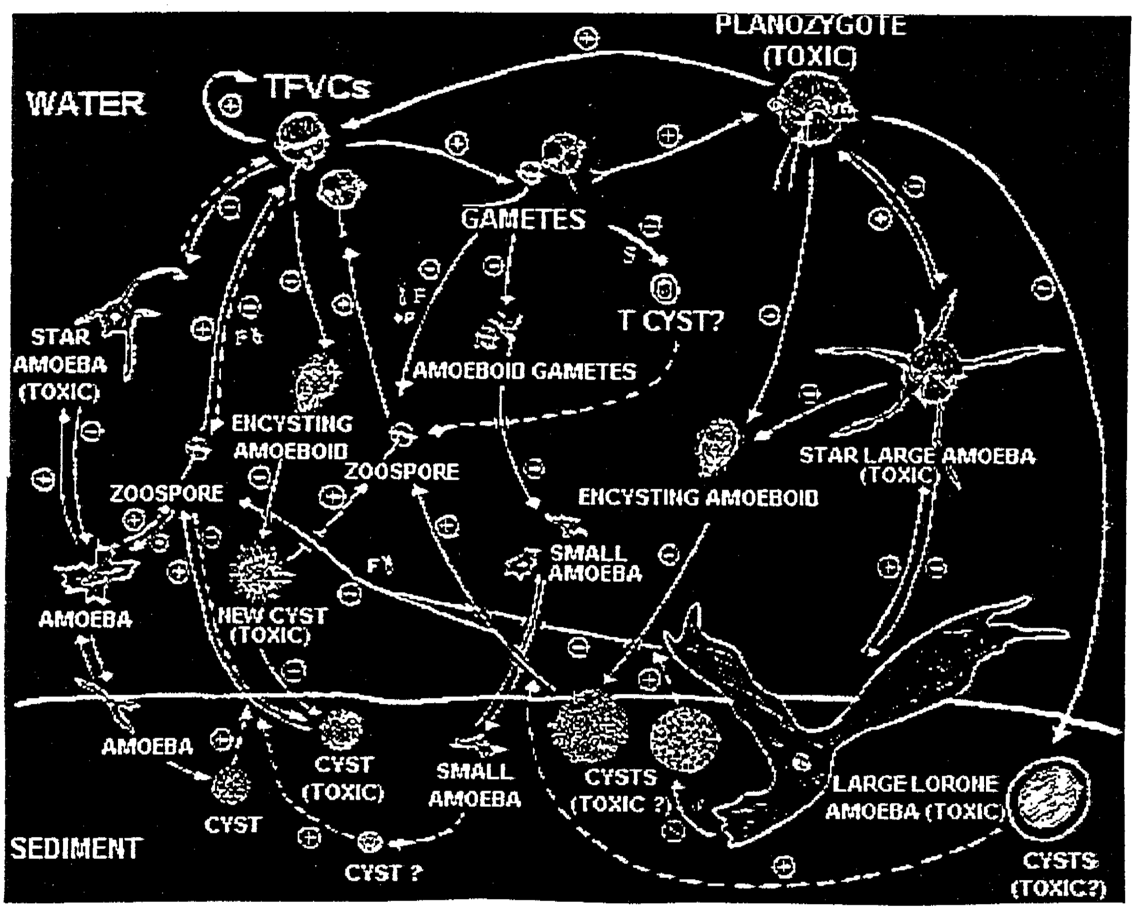


Figure 20. Diagrammatic life history of *Pfiesteria piscicida*.
Source: NCSU 1998.

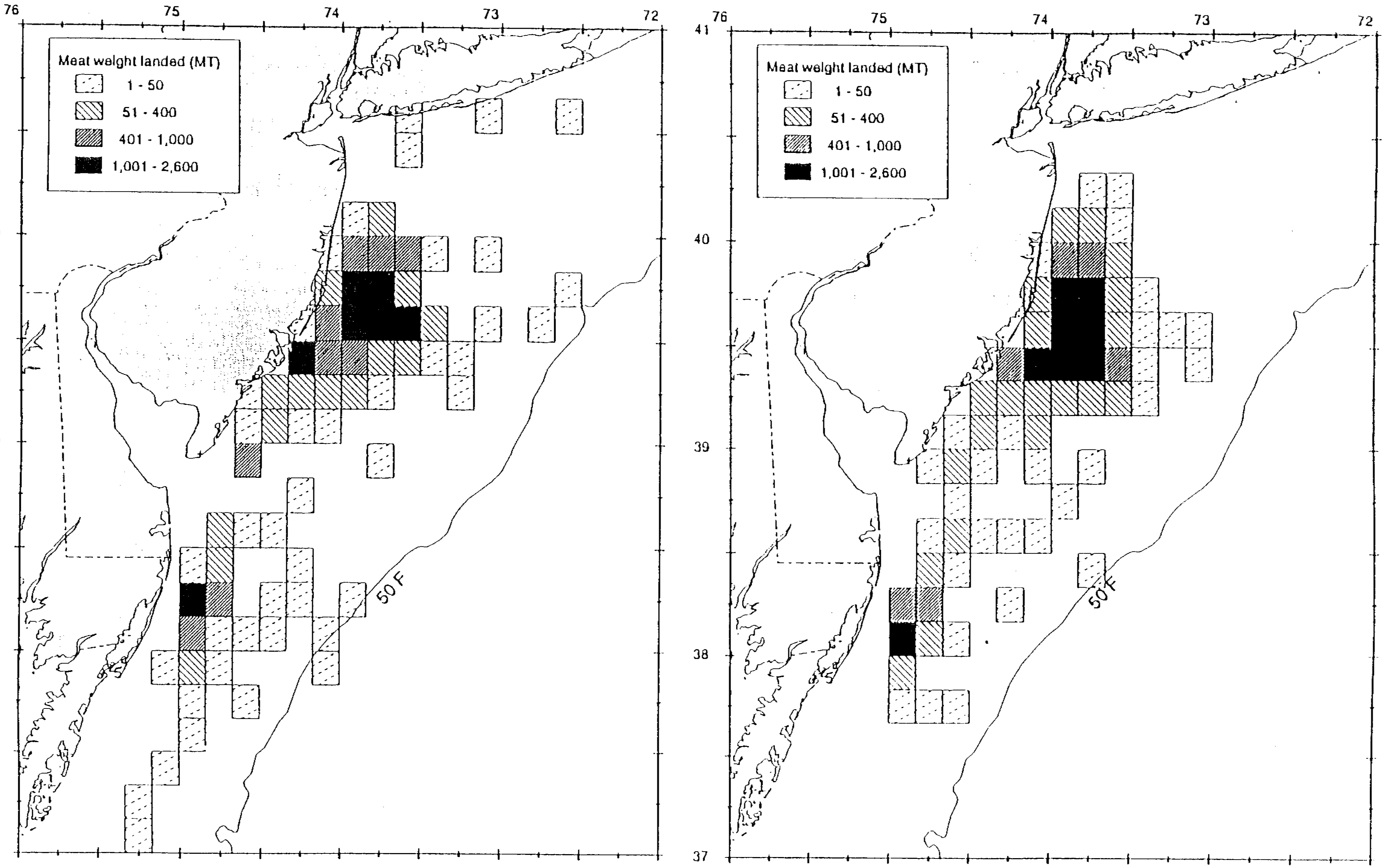
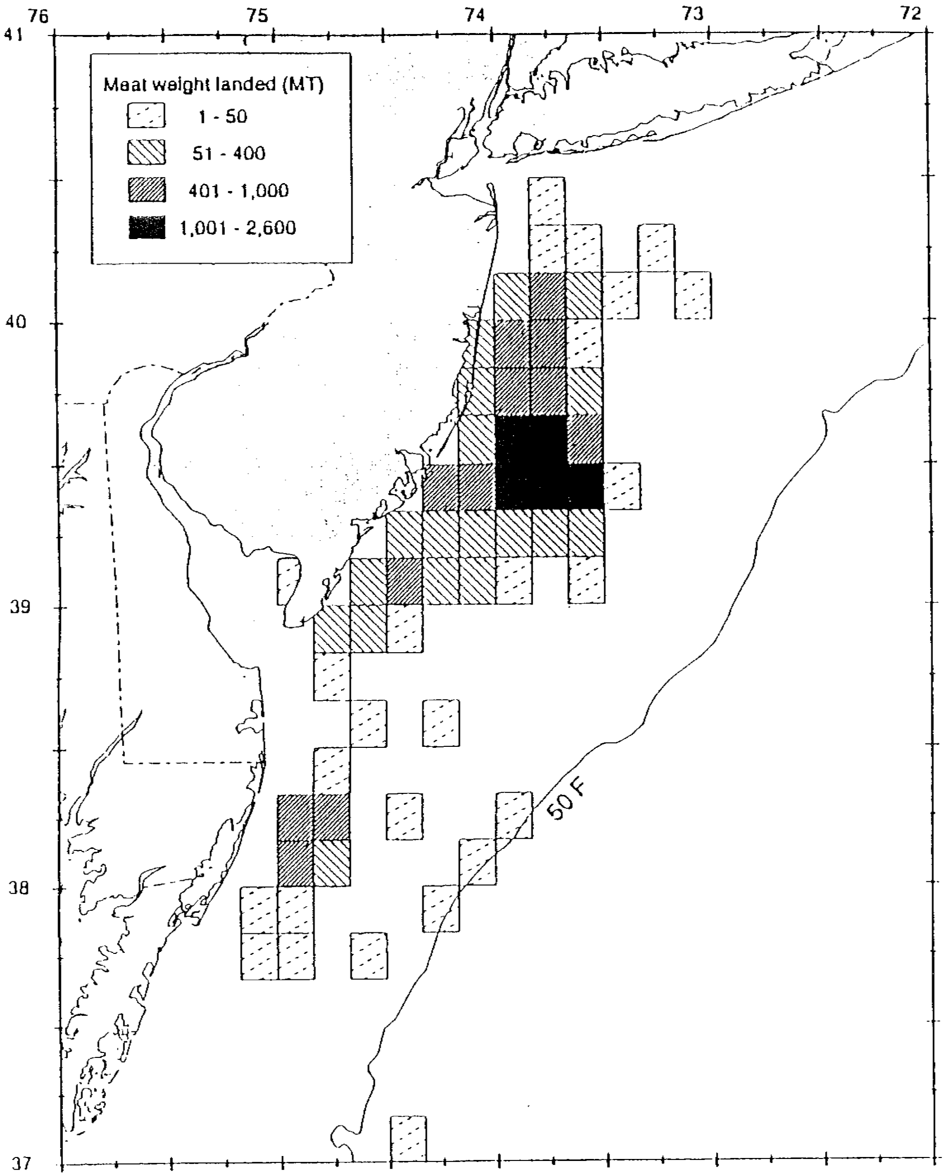


Figure 21. Distribution of surfclam landings, by 10 minute squares, during 1994 (left) and 1995 (right). Source: NEFSC 1998a.



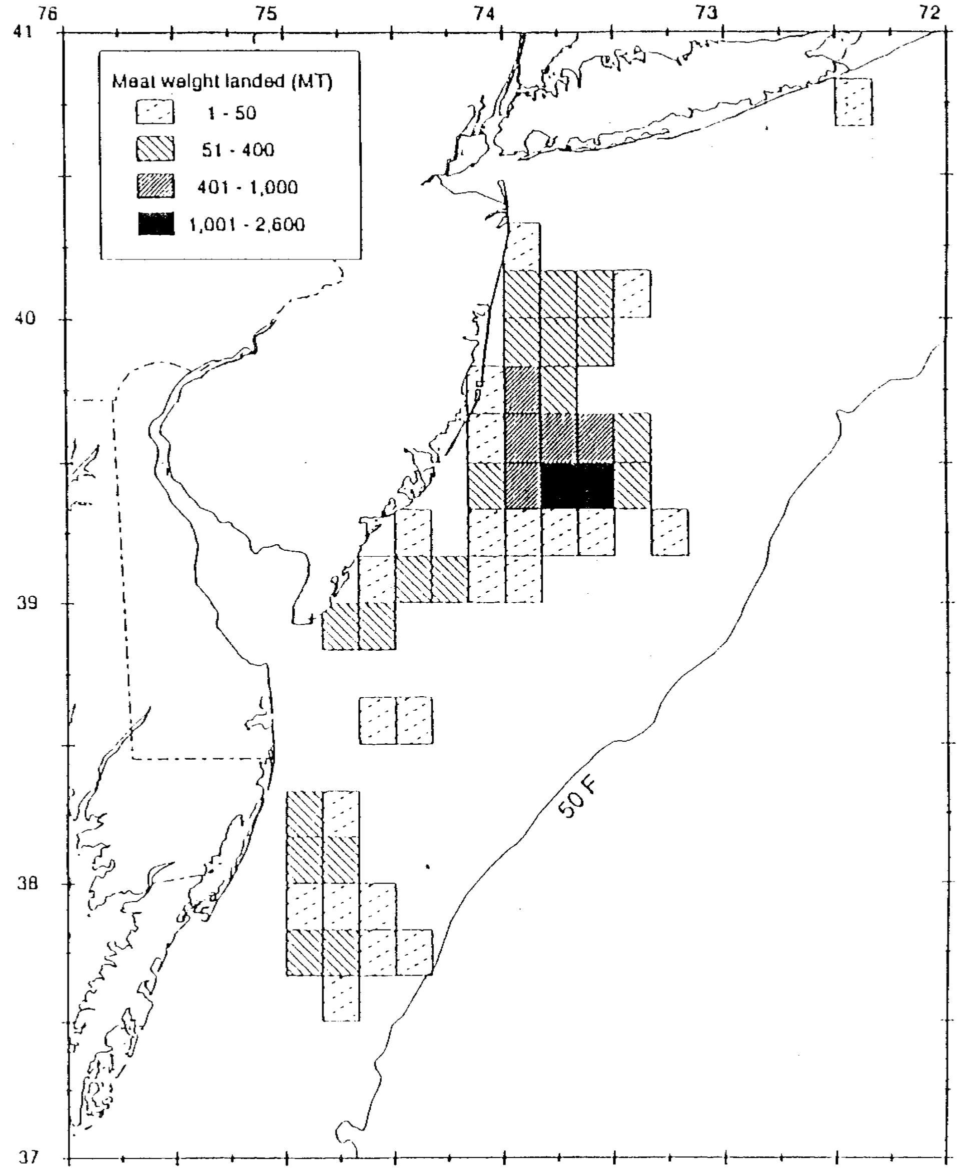


Figure 22. Distribution of surfclam landings, by 10 minute squares, during 1996 (left) and 1997 (right). Source: NEFSC 1998a.

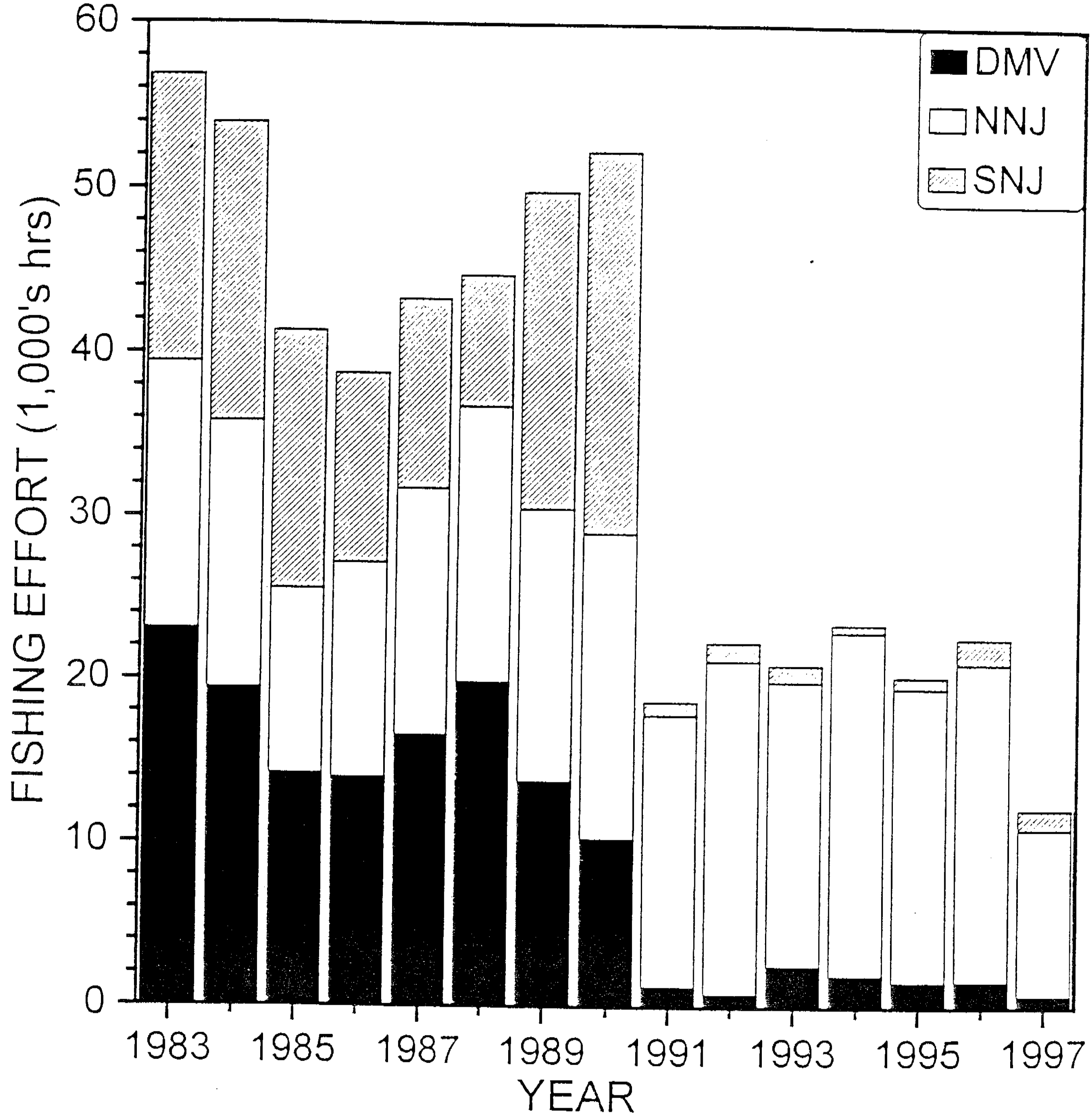


Figure 23. Total reported hours fishing during surfclam trips, by region year. 1997 data do not represent a full year.
Source: NEFSC 1998a.

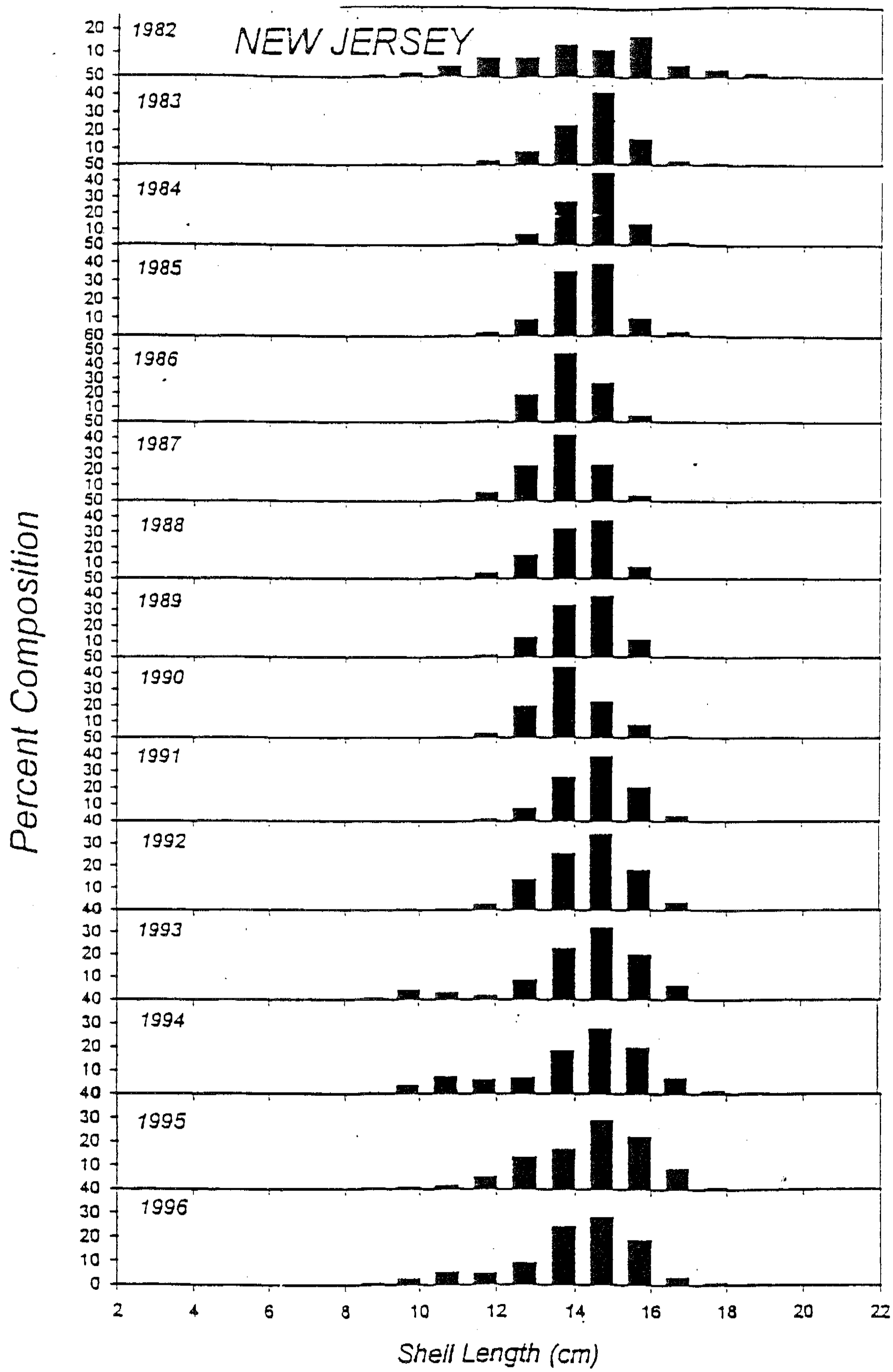


Figure 24. Surfclam shell length (cm) frequency, 1982-1996, in New Jersey.
Note: 1 inch = 2.54 cm
Source: NEFSC 1998a.

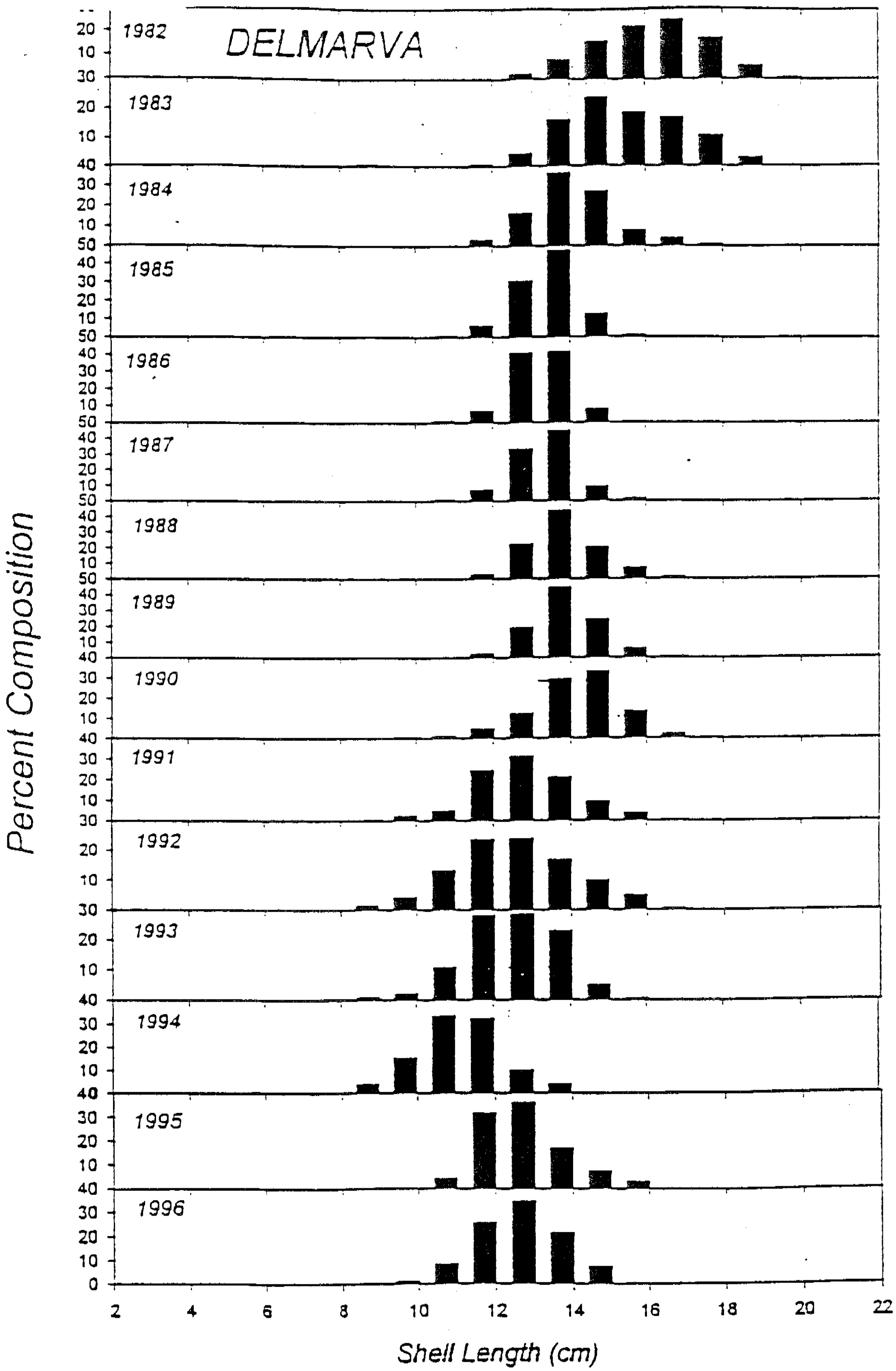


Figure 25. Surfclam shell length (cm) frequency, 1982-1996, in Delmarva.
Note: 1 inch = 2.54 cm
Source: NEFSC 1998a.

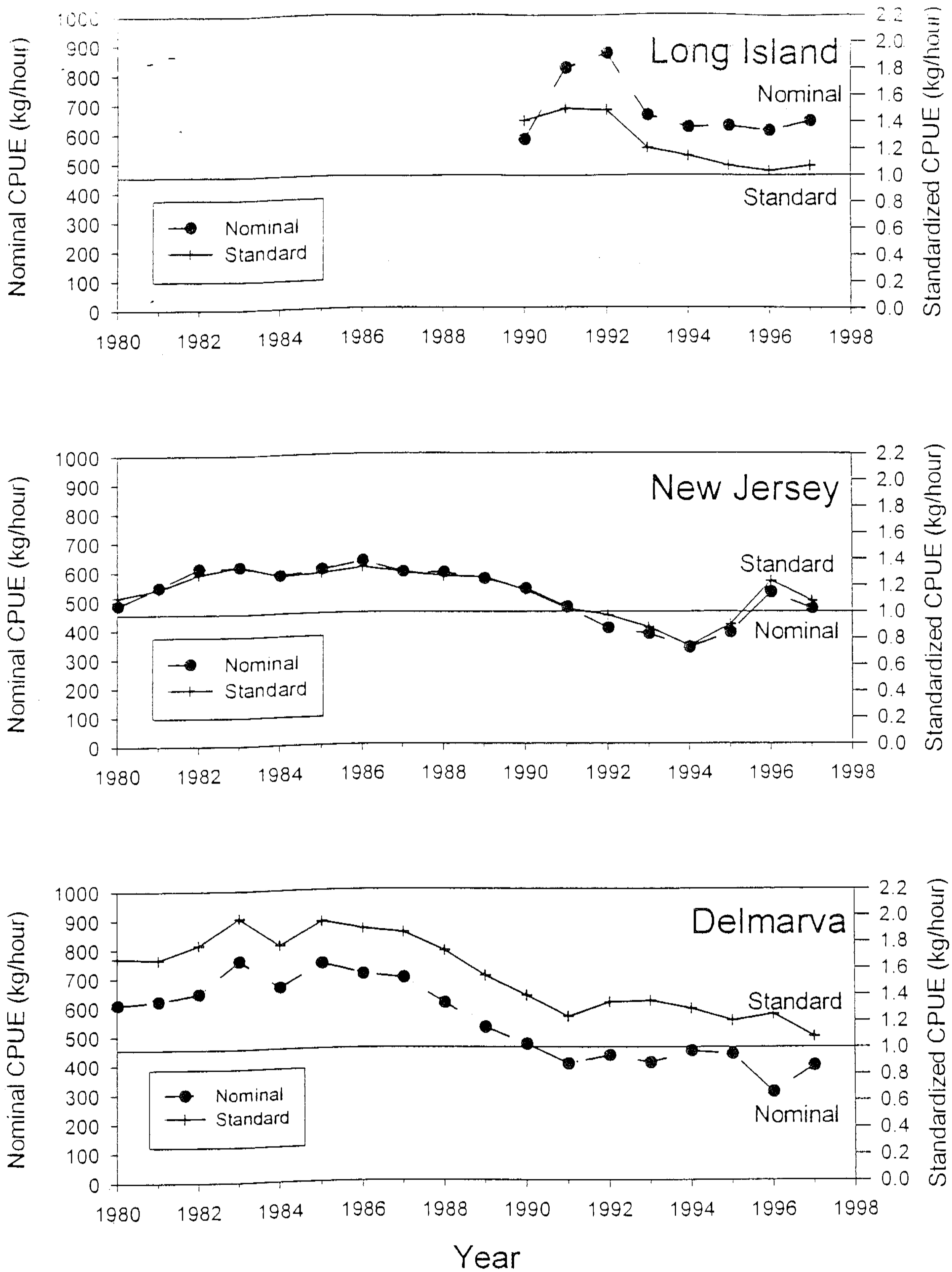


Figure 26. Nominal and standardized catch per unit of effort by class 3 vessels fishing ocean quahogs of Long Island, New Jersey, and Delmarva.
Note: 1 kg = 2.205 pounds
Source: NEFSC 1998b.

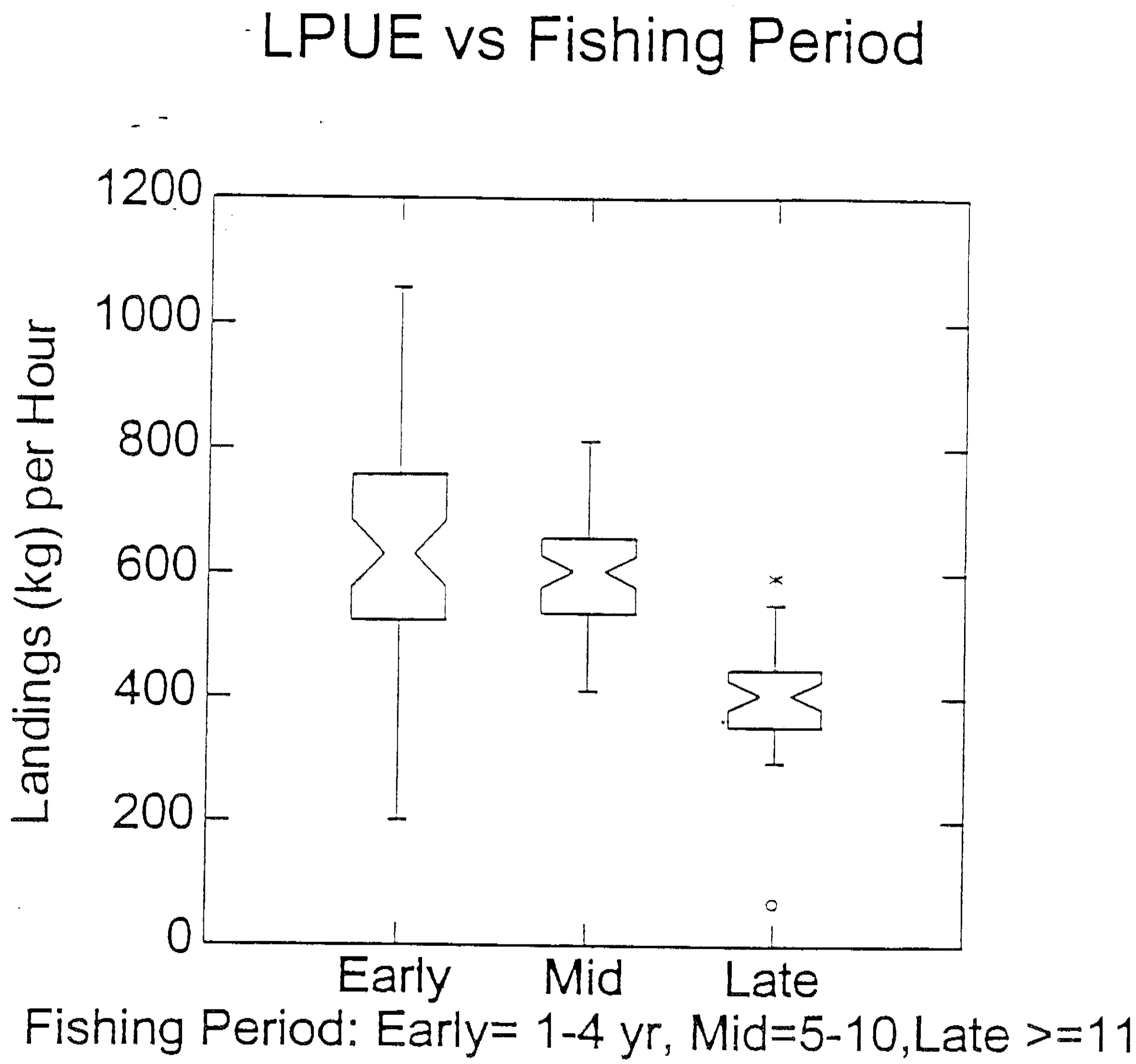


Figure 27. Ocean quahog catch per trip in heavily fished 10 minute squares as a function of years of exploitation. Shown are the median and box enclosing the 25th and 75th percentiles.
Note: 1 kg = 2.205 pounds
Source: NEFSC 1998b.

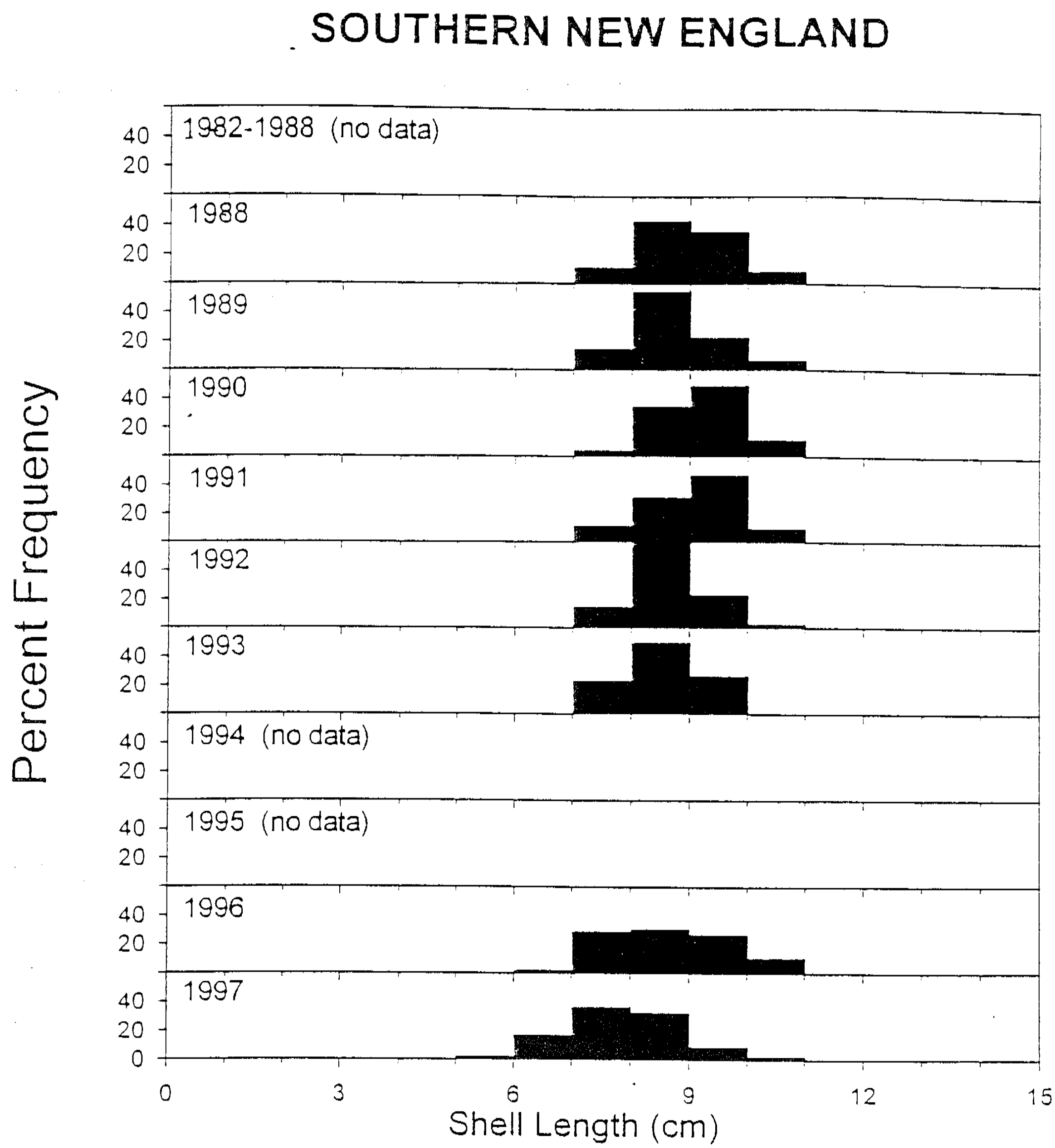


Figure 28. Ocean quahog length frequency distributions derived from port samples. Trips were catch-weighted.
Note: 1 inch = 2.54 cm
Source: NEFSC 1998b.

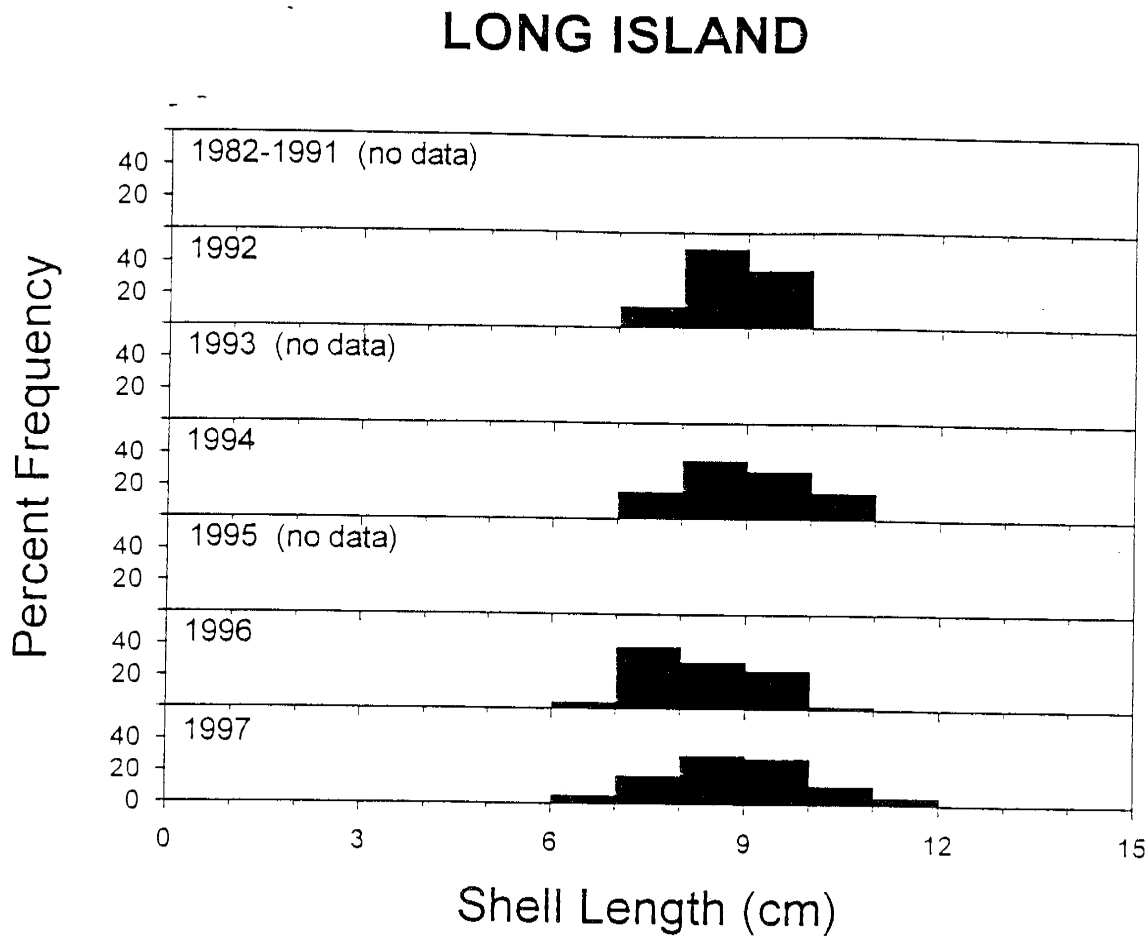


Figure 29. Ocean quahog length frequency distributions derived from port samples. Trips were catch-weighted.
Note: 1 inch = 2.54 cm
Source: NEFSC 1998b.

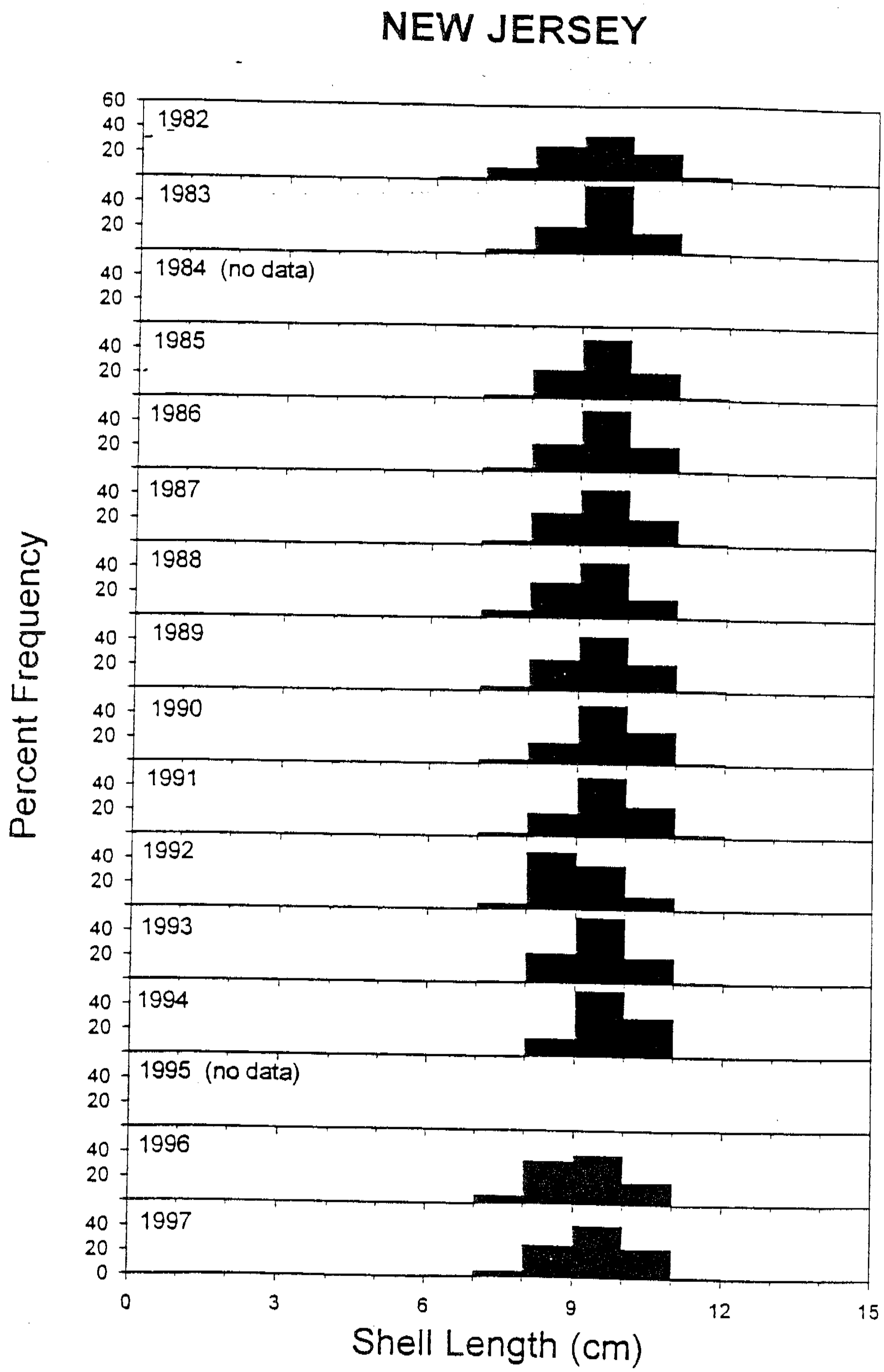


Figure 30. Ocean quahog length frequency distributions derived from port samples. Trips were catch-weighted.
Note: 1 inch = 2.54 cm
Source: NEFSC 1998b.

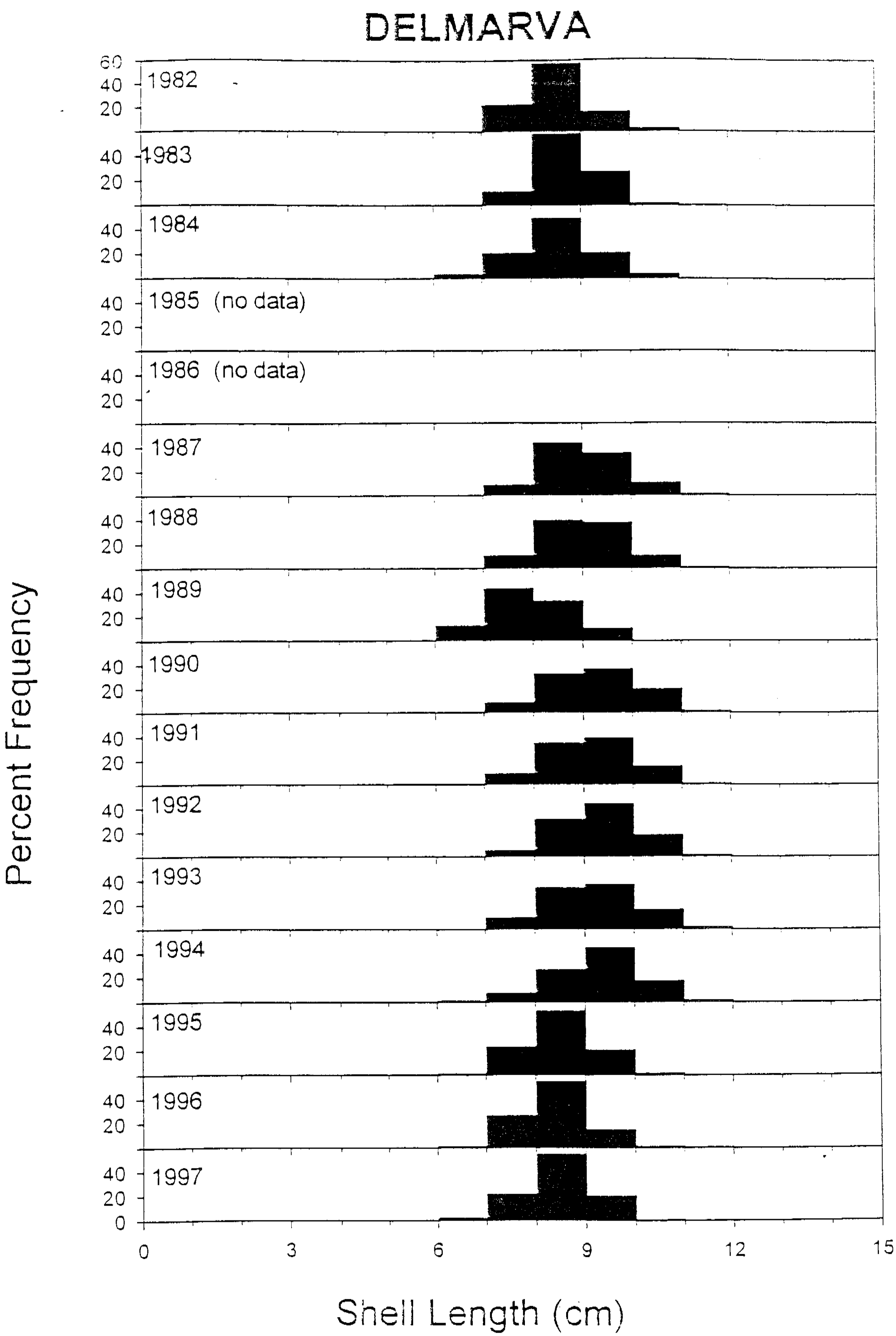


Figure 31. Ocean quahog length frequency distributions derived from port samples. Trips were catch-weighted.
Note: 1 inch = 2.54 cm
Source: NEFSC 1998b.

National Marine Sanctuary Program

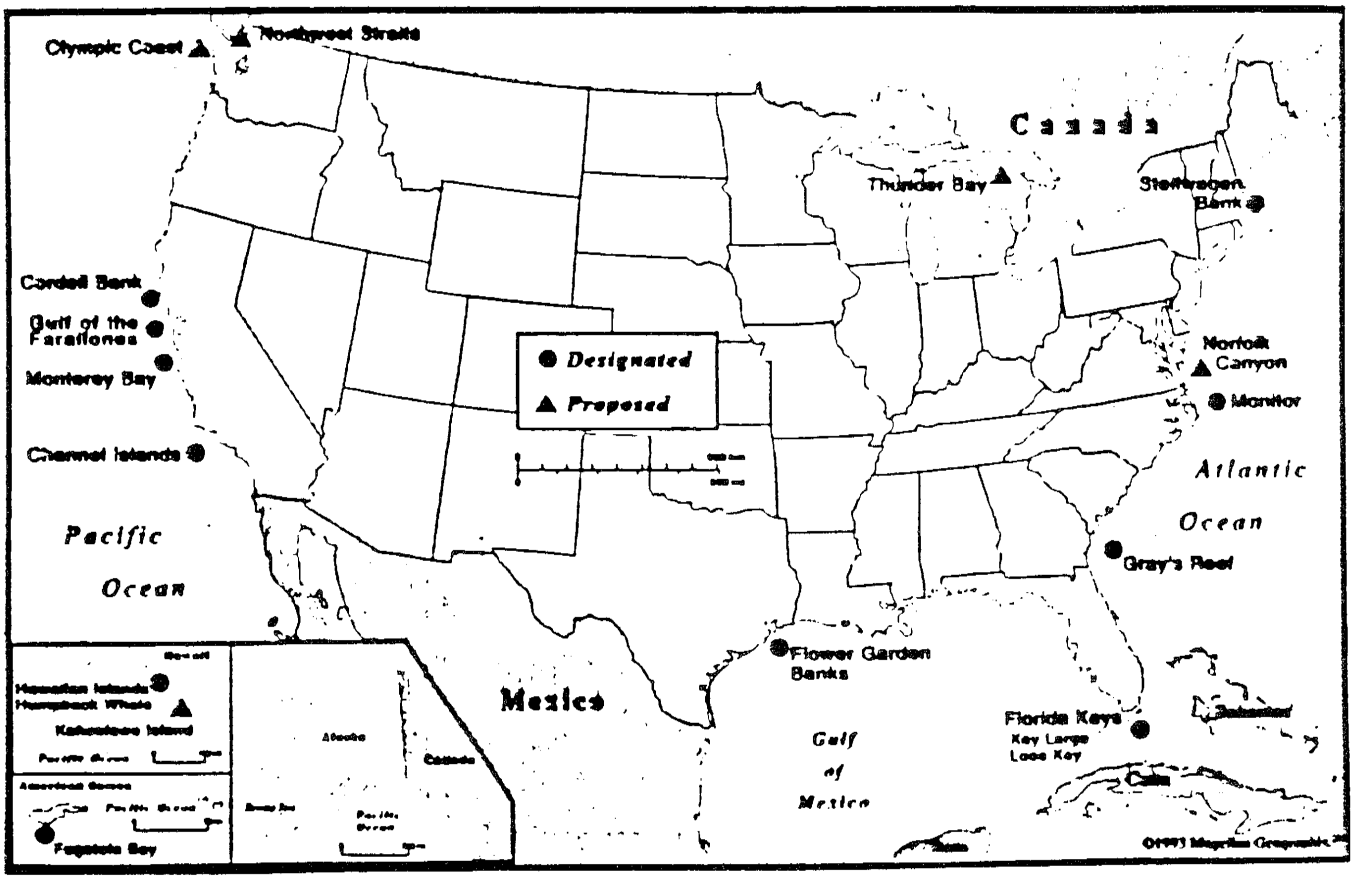


Figure 32. Designated and proposed National Marine Sanctuaries.
Source: National Marine Sanctuaries Program 1993.

APPENDIX 1. PUBLIC HEARING SUMMARIES

Amendment 12 to the Summer Flounder, Scup, Black Sea Bass Fishery Management Plan, Amendment 8 to the Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan, and Amendment 12 to the Surfclam and Ocean Quahogs Fishery Management Plan

WARWICK, RI - SEPTEMBER 8, 1998

The hearing was opened at 6:00 PM by hearing officer Dick Sisson. Mr. Sisson presented the SFA Amendments.

Comments on Amendment 8 to the Atlantic Mackerel, Squid and Butterfish FMP

Mike Tarasevitch stated that as long as the Council is talking about a target TAC for *Loligo*, there should be some sort of reasonable trip or possession limit so that the TAC is not caught up too early in the season. The trip limit should be reasonable, perhaps 30,000 pounds. If they have a big winter and the quota gets all caught up by May we won't be able to catch anything.

Dan Cameron, crew member on the Atlantic Star, wanted to comment on the vessel size and horsepower restrictions proposed in the Atlantic mackerel fishery. He read a prepared statement which is attached (see Attachment 1).

Comments on Amendment 12 to the Atlantic Surf clam and Ocean Quahog FMP

George Richardson, Blount Seafood Corp., stated that as he reads the overfishing definition, the Council is going to use the biomass from the Northern New Jersey Area, which is a relatively small area, as the criteria for setting the whole quota. In my mind this is effectively putting a management practice in place of an overfishing definition. I object to this, from the industry point of view. I would like to see this stricken from the amendment and some other criteria put into it's place which is similar to the quahog criteria. I would rather see the fishery managed on a biological basis rather than the economic criteria they are currently using. The biology suggests that we now have six times as many clams as we had last year based on the recently updated surveys. This seems like a contrived way to keep the quota low and I do not like it in any way. I support the old Council policy of extracting 10 % of the biomass per year and maintaining a ten year window of opportunity, this was a sound practice. The quahog portion is ok.

Comments on Amendment 12 to the Summer Flounder, Scup and Black Sea Bass FMP

Mike Tarasevitch stated that I am also on every mailing list and all I received was a brief summary. How am I supposed to comment on a 300 page document I just received. Also, I thought I was coming up here to comment to members of the Mid-Atlantic Council. They were going to send that guy Rich Seagraves up here to take our comments. Who is he? He's not even a voting member of the Council. They should at least send someone up here to listen to our opinions and concerns who is going to vote on this. I hope they transcribe this and I just want to say to members of the Mid-Atlantic Council that I protest this meeting. We are being shafted on this whole process, and I personally demand another meeting. I had some questions for the Council members about what their thought processes were and the fact that they were only going to send one person up here means they are treating us like zero. These scup and fluke issues are very important to this state. I hope that these comments go on to the Mid-Atlantic Council, that the fishermen of Rhode Island are being shafted and I am going to complain to my congressman. We should have another meeting with members of the Mid-Atlantic Council present to listen to our views. Don't we have a liaison to the Mid-Atlantic Council. Who is he? Jim O'Malley, where is Jim O'Malley? I agree with John Kurtesis, I believe that Jim O'Malley should be kicked out as the representative for the State of Rhode Island. This is a joke, there is nothing going on right now that is more important for Jim O'Malley than to represent the fishermen of Rhode Island. I apologize if he had a death in the family, otherwise he should be kicked out, thrown out.

John Kurtesis, Tiverton RI, stated that he is on all the mailing lists and all he received was a brief summary of the Atlantic mackerel amendment. I have a 300 page document and I have no idea what is in it, how can I comment on it? This is crazy, we came in here blind. I agree that this process is totally crazy, having just a state guy here. We want members of the Mid-Atlantic council here - now.

John Carvahlo, stated that they way the hearing is being run , the idea that the fishermen have more time to comment in writing, that practice is not acceptable. The kind of written testimony that the Council is asking for is hard for fishermen. These public hearings are supposed to be an opportunity to express ourselves verbally rather in writing. I don't think that this process is in the spirit of any administrative procedure normally followed during the adoption of an FMP amendment. We fish for many different species, we do not have time to attend every hearing and respond in writing to every management plan for species that we fish for, that would be impossible. We are fishermen, we are not in the business of providing written testimony. We are subjected to this bureaucratic maze for every species. I could write lengthy testimony on the scup mesh size regulation alone. Our discards are not the problem with scup, you have a small group of people in the ocean fishery that are responsible for 90% of the scup discards, yet the rest of us are being beaten to death over this issue. They are going to bankrupt the entire inshore fleet over this issue. That is not what the Sustainable Fisheries Act was intended to do.

Several fishermen at the hearing submitted a petition (see Attachment 2).

Dick Sisson wanted to keep the hearing open to allow additional comment.

NORFOLK, VA - SEPTEMBER 8, 1998

Hearing officer Rob O'Reilly (filling in for Jack Travelstead) opened the hearing at 1810 hours. Twenty six individuals from the public were present. Council member Bill Wells attended. Tom Hoff of MAFMC staff attended.

Comments on the Summer Flounder/Scup/Black Sea Bass FMP were received first.

Dean Isaacson, Papa-si Fish Company, stated that there is no need now for additional management measures on black sea bass.

Luke Negangard questioned whether black sea bass rod and reel fishermen would need any additional permits under this Amendment. He stated that we should make sure we do not put him out of business.

Tim Daniels, Old Point Packing, stated that frameworking management measures was not a supportable idea because of the long term nature of business planning.

William Nuckols stated that the public has a hard time telling where EFH is from the maps in the documents.

James Fletcher, United National Fishermen's Assoc., provided a written statement (see Attachment 3). He said that the information is flawed. Amendment 12 should not be submitted to the Secretary because the information is wrong. Summer Flounder/Scup/Black Sea Bass has all bad information and it is wrong to consider these species overfished. The summer flounder MSY should be what Chang and Pacheco said it should be two decades ago, 44 million pounds. There should be a retrospective analyses done on Chang and Pacheco, who had put a higher F on the table than the F=0.24. The Congressional mandate of the October deadline should not drive the process. The document is wrong. The science is wrong.

Bill Wells acknowledged that Fletcher had some points. Summer flounder will need to be reviewed. The Council is recognizing that something is not tracking in the FMP.

Mark Hodges, Hodges Seafood Ltd., questioned the historical data. He requested that we send him the black sea bass SAW report.

Comments were then received on the Atlantic Mackerel/Squid/ Butterfish FMP.

Jim Ruhle, FV Darana R, stated that the SFA was forcing the Council to jump through hoops. There is lots of pressure and the MAFMC is not performing up to our normal standards. Under no circumstances should the MAFMC try to follow the NEFMC approach, as it is doing with the frameworking measures. The NEFMC track record is not good. The Council does not have the capability to affect 90% of the proposed frameworked measures. One can not change the horsepower within the season. The frameworked measures will not work. NMFS is not putting all their cards on the table, i.e. squid quota was never mentioned at the last Council meeting until the end of the meeting, and now *Illex* will be closed. The same is true with summer flounder. With the SFA overfishing requirements, the decrease of 1000 mt for *Illex* is only mathematics. Congress has put MAFMC under a lot of pressure and it should not be under that pressure to simply meet a deadline. The frameworking measures are not fair to the industry. One can not shuffle the deck in the middle of the year. The community descriptions have changed significantly from McCay in 1993, i.e. Wanchese numbers have changed significantly. The FMPs need to have updated community information.

James Fletcher, United National Fishermen's Assoc., stated his opposition to the permit requirements in Amendment 8 which requires extensive landings. Fishermen with permits for years should be able to fish even if they had no landings. If a fisherman did not have the permits, then he can not fish, but if he had permits then should be able to keep the permits and fish. Same rules apply as flounder and scallop permit holders. They need fishermen to be able to switch back and forth among various fisheries.

Finally the third set of comments were taken on the Surfclam/Ocean Quahog FMP.

John Miles, JH Miles & Co., Inc., buys the majority of the landings that come from Delmarva region. He is opposed to the proposed surfclam overfishing definition because it is based on Northern New Jersey (NNJ) production. The Council is setting unreasonable restraints on the quota. He can not sell the high value clams of NNJ in his process. He stated the objectives of the FMP are for the range of the resource. He stated that if the quota were to increase significantly then Delmarva clams would be more economically valuable. Lots of clams in Delmarva.

Tim Daniels, Old Point Packing, wanted to know how someone could get into the ITQ clam fishery.

James Fletcher, United National Fishermen's Assoc., said the clam ITQ system was set on false information. We should allow for the diversification of the clam fishery and allow more fishermen and processors to get into the clam fishery.

David Moore, JH Miles & Co. Inc., agreed with John Miles about the proposed overfishing definition being based on Northern New Jersey.

Finally, a call for any additional comments produced one.

Jeff Dean stated that summer flounder are rebuilding and no further measures are needed. Good people do not need further hardships.

Mr. O'Reilly closed the hearing at 2015.

RONKONKOMA, NY - SEPTEMBER 9, 1998

The hearing was opened at 6:06 PM by hearing officer John Mason. Council staff present included Rich Seagraves.

Mr. Seagraves presented the Amendments.

Comments on Amendment 12 to Surf Clam and Ocean Quahog FMP

Dave Aripotch commented that this was the only FMP in the country that would make out better under the new SFA.

Mike McCarron stated that there was still ocean quahog quota left, but clammers have no market. If they could work on the quahogs this would take some pressure off of the other species which are overfished. Why can't this excess quota be utilized?

Comments on Amendment 8 to the Atlantic Mackerel, Squid and Butterfish FMP

Mike McCarron is concerned about the Council policy of eliminating joint ventures for Atlantic mackerel. He feels they offer an option for the fishing fleet to catch mackerel and wants the Council to allow JV's in the future. Since *Illex* is closed, many of the large boats will switch to *Loligo*.

Dave Aripotch also stated that the commercial fishermen need other options. The JV specification for mackerel would give fishermen options. The framework measures proposed in Amendment 8 would have been useful in extending the *Illex* season this year, therefore he favors the framework mechanism being proposed. He was very dismayed that under the description of fishing communities section that the ports of Montauk and Shinnecock were not included or described in the document. Why were they left out? How can this analysis be complete without a complete description of the New York fishing ports? He was opposed to the restriction on vessel size in the Atlantic mackerel fishery.

Comments on Amendment 12 to the Summer flounder, Scup and Black sea bass FMP

Albert Lindroth, stated that the economic impact analysis of the party/charter boat fleet was not adequate. He attended a meeting in Ocean City, MD where he was assured that there would be minimal economic impact on the party/charter fleet fishing for black sea bass. But his business is down 26% in June and 16% in July. This is an economic impact. At the same time VA boats are catching 2,000-3,000 fish per tow while we are closed. Pot fishermen are also catching fish, they are allowed to continue to fish. Seven boats along the east coast are taking the hit from this closure. The Council did not have their facts on economic impact, the two week closure cost him 26% of his business even though the weather was good. Why wasn't the economic impact of this discussed?

Sarah Chassis, representing the Natural Resource Defense Council wanted to address some of the summer flounder issues. The NRDC will be commenting in writing on the other amendments. They are concerned that with the adoption of the current schedule the Council has failed to adhere to the plan. The summer flounder TAC for 1999 has less than a 5% chance of meeting the target for rebuilding. The resulting increase in fishing mortality jeopardizes the 10 year rebuilding plan. This Amendment does nothing to address this problem. Specific measures should be included in the amendment to meet the rebuilding schedule. The landing limits should have a significant chance of meeting the rebuilding goals. Measures need to be implemented to avoid recreational over-runs. The framework measures do not propose any specific measures. Also, better measures to deal with the discard issues in the fishery are needed. In terms of EFH, they support the 90% designation, perhaps 100% would be more appropriate. Habitat loss has been identified as a contributing factor in the decline of the summer flounder resource. They are troubled by the language that only the EEZ portions are EFH. The area designated as EFH should be 90% of the total habitat, state or federal. They also recommend that the data be made ecologically coherent. The area south of Cape Hatteras to Florida should be included. They support the inclusion of estuaries in the EFH designation. Also the small coastal bays and tidal streams should be included. Submerged aquatic vegetation is important and should be included. The amendment does a good job on non-fishing threats to habitat, but there is no proposal to address the impact of fishing on habitat.

Mike McCarron, F/V Jaime Elizabeth, sated that EFH is the up and coming issue. If fishermen were harming or destroying habitat, why do they return to the same areas of bottom year after year? He is very concerned about where we are going with this EFH issue. What about the mussel beds? If the Council is worried about habitat, how about the dredging of New York harbor?

John MCCormick, Capt. Lou Fleet, doesn't want any changes in the fluke regulations. It is getting harder and harder to catch fluke as it is. They won't be able to survive with stricter regulations. They can't survive with a minimum size greater than 15" or a bag limit less than 8 fish. He also wanted to comment on the MRFSS data. He has been fishing for over 20 years and not once has he ever seen a MRFSS interviewer at his dock. He strongly suggests that the logbook data they submit be used instead of the MRFSS data. In addition, future meetings should be held after 7:00 PM so those who fish for a living can attend.

Mike Barnett, Codfather Charters, wanted to reiterate what John said about the effect that these regulations have on communities. If the Council continues to tighten up the regulations on fluke, he will not be able to survive. He sends in his reports. There should be a better evaluation of the economic impact of the regulations. The same goes for sea bass and scup. They have taken all the hits they can on these species.

Fred Kieser, Scamp V, stated that the Council must take a better look at the economic impacts of these amendments. The port and community description does not even mention the party and charter boat fleet or tackle shops. How can the Council make decisions without the proper economic impact analysis? With respect to sea bass, originally the last two weeks were supposed to be closed. Then is was changed to the first two weeks. People booked charters based on the original information. He had to cancel the charters because it wouldn't be fair to his customers. He needs to book his charters at least 6 weeks in advance. He urged the Council to adopt a management strategy and to stick with it. Don't change at the last minute, that cost him a lot of money. He is absolutely opposed to the framework process or changing the regulations in mid-stream.

Nick Manzari, Captree Boatman's Association, was concerned that in the economic analysis section, the party/charter boat industry is not even mentioned. He feels that summer flounder fishery is the brightest part of the industry, but the industry needs consistency. He is opposed to changing the minimum size limit. He feels that the hooking mortality estimate currently being used is too high. He wants the Council to look at seasons or go to a larger hook size.

George Bartenbach, Captree Boatman's Association, stated that the party/charter boat industry can't be cut back any more. The 15 inch size limit and 8 fish bag limit is enough. The season is getting shorter and they are at their limits with the current regulations. He wants consistency in the regulations.

John Robinson, party boat *Rosie*, stated that they need the 15" size and 8 fish possession limits. If you increase the size limit, you will only increase discards. If you decease the bag limit, his customers will limit out in an hour, then what are they supposed to do?

Patrick Gillen, Captain Gillen Fishing Corp., agrees with the other party/charter boat fishermen. He is opposed to the framework provision and thinks it would cause a hardship on his business.

Dave Aripotch, F/V *Cory and Leah*, noted that the SSB for fluke has increased seven fold. The F=0.33 is probably too restrictive. The fluke stock is rebuilding, the fishery is now in the NMFS kill and release program. National Standard 9 is not addressed in the Amendment. The FMP regulations are causing discards and the amendment does not address the problem. There are hooking discards, page 228 states that the discards are 7% in 1997 yet on another page it states they are 13.9%. Your own document is inconsistent relative to discards. The economic impact on communities is not described in the document. Montauk is the largest fishing port in the state of New York and they are not even listed in the port description section. How can the Council evaluate impacts on communities when the largest port in the state is not even listed? He is concerned about the NMFS policy with respect to aquaculture and fluke, they are backing it. On page 144 he disagrees with the statement that fluke are still over-exploited. The document states that F declined to 0.61 in 1997, which is proof that the stock is rebuilding. The SSB has increased seven fold in six years, how can the stock be over-exploited? On page 149, the document specifies recreational logbooks, does the Council mean party/charter logbooks? The document also states that the FMP may have had some impacts. The Council does not want to face the fact that they are killing us. He is sick of throwing over dead fluke. On page 218 there is a description of the impact of fishing gear. What are unknown gear types, and how can the Council conclude that there are no expected impacts if they do not even know what the gear types are? On page 204 there is a section that says that boulders were moved, how did they know this to be the case? That's horse shit. There is nothing in that section on fishing gear effects off of Long Island. There is nothing in there about hook and line fishing, you are singling out dragging gear. With respect to EFH, he favors halting all development in the coastal zone. The number of sportfishing boats should be reduced, they are polluting the water with their outboard motors but there is no mention of this in your document. The statement on page 154 "by maximizing the number of fish alive.." is false. The document also states that we are maintaining optimum yield, if this is so then we have already rebuilt the stock and we do not need quotas any more. This Amendment does not satisfy National standard 9, does the Council really believe that it does? On page 154, the last sentence is contradictory. Also, when the commercial fishery goes over their quota, the overage is deducted from the quota the next year. Why don't the same rules apply to the recreational fishery? If they go over their quota nothing happens. He favors the frame working procedure, it has proven to be useful in multi-species groundfish management in New England.

Dennis Kanyuk, noted that there has been a big increase in the fluke population, everyone knows this. Why does the Council want to increase the size limit. Common sense would tell you that the stock is rebuilt. Maybe we are already where we want to be. The Council is making management decisions , affecting peoples lives, using statistics that are old. There must be more fluke than you think. Don't change what you have going, it is working. There seem to be a tremendous number of fluke out there. The Council statistics must be off. The hook and line mortality assumption of 25% is way too high. He could live with an increase in hook size, but they can't live with any more regulations. With respect to EFH, he would like to see the Council ban the use of roller gear. He is concerned that the goals for stock rebuilding are unrealistic, where are you going to put all of these fish, what will they eat? He is opposed to inn season adjustments to the management measures. There is too long of a lag between the statistics and management actions, yet you make decisions that affect our livelihoods anyway. The fishery managers should take a pay cut when the fishermen have to. The meeting was held too early. Party/charter boat fishermen can't sell their fish, this is not fair. Why does the Council keep raising the size limit, every time you increase the size limit we land more bigger fish so the poundage goes up. We need to catch more fluke, not less. During the years that the recreational fishery was under their quota, why didn't we get any credit for that?

The hearing was closed at 8:30 PM.

CAPE MAY COURTHOUSE, NJ - SEPTEMBER 9, 1998

Hearing officer Bruce Freeman opened the hearing at 1810 hours. Seven individuals from the public were present. Council member Charlie Bergmann attended. Tom Hoff of MAFMC staff attended.

Comments on the Summer Flounder/Scup/Black Sea Bass FMP were received first.

Charlie Bergmann, speaking only for himself, provided several comments. There needs to be a better way for communicating with the public especially concerning acronyms. He is very uncomfortable with the overfishing definitions. There are not estimates of MSY as mandated in the law and the information is not timely. NMFS is not allowing the Council to do its job.

Daniel Cohen, Atlantic Capes Fisheries, supports the framework mechanisms since Plan changes take 2 years. These FMPs are pressured by time limits set by Congress and they are filled with lots of "guesses". He also questioned what the EFH impacts were to the commercial and recreational fishermen.

Paul Thompson stated he has lots of trouble understanding the acronyms. Recreational fishermen are better educated now than in the past, i.e. they are releasing small female black sea bass.

Comments were then received on the Atlantic Mackerel/Squid/Butterfish FMP.

Charlie Bergmann is in total support of restrictions on limitations. He supports attempts to control the overcapitalization of the fishery. He questions the surplus production model for *Illex*. There are problems with vessels being under artificial constraints which may affect effort. Several ports were under trip limits. The assessment used port agent intercepts rather than logbooks. He can not contemplate using overfishing definitions since analyses are flawed because of effort being artificially constrained. We should have more information on *Loligo* than we do on *Illex*. Landings of *Illex* in the 1970s were 150,000 mts and levels now should not be limited to only 18,000 mt. He would like NMFS to somehow use the information on the location of the Gulf Stream in the next assessments.

Dan Cohen, stated that the scientific guesses for *Illex* are now impacting the fishery. He requested the Council request an *Illex* assessment for December. He also requested the Council schedule two framework meetings for February and March for *Illex* quota changes. The Council has chosen 75% and he suggests that we use 100% for next year, to close the directed fishery. He knows the issues can be frameworked. The 75% is not required by law and therefore we can use 100%, especially if there is no new SARC.

Finally the third set of comments were taken on the Surfclam/Ocean Quahog FMP.

Eric Powell, Rutgers University, feels strongly that industry and academics should have been involved in the proposed overfishing definitions. For surfclams the Fpo, replacement fishing mortality, worked well in the calculations for the first year. It is an excellent approach, but we should not codify a model with only one year worth of data. The production model is not appropriate for overfishing definition because we may need to overfish Delmarva. We may need to reduce Delmarva by 1/4 to ½ of biomass to maximize the productivity. He suggested we use other F measures for surfclams like F0.1 for overfishing, while recognizing that the quota will be set with the production model. He proposes a one day meeting at Woods Hole of the Invertebrate Subcommittee to develop different overfishing definitions for surfclams. He will provide written comments before the close of the comment period on the 25th.

James Roussos, Cape May Foods, opposes the overfishing definition being associated with Northern New Jersey (NNJ). He does not believe the health of Delmarva surfclams should be tied to NNJ. The big end users perceive the clam industry as a dead one. Industry is too constrained. Any increase in the quota will be a positive signal to the industry users. He questions industry for product development and the time needed. He wants to see a growing industry. Currently the market is weak for surfclams.

Dan Cohen spoke about the precedent of management throughout the range as opposed to localized overfishing in the NNJ area. He spoke in favor of area management. He would like to see the Council/industry develop a process of orderly growth for the next five years.

Finally, a call for any additional comments produced a few.

Dan Axelsson, H & L Axelsson, Inc., spoke to *Illex*. It was a good year for *Illex*. Most of the landings were made by 20 boats. *Illex* quota has always been too low. Low catch because of low effort. 1998 was a high effort year. Most of the catch was made by RSW boats. He feels the quota can be increased because the amount of fishing at the edge of the Gulf Stream can be increased. The quota can be increased to at least 30,000 mt. We could move the start date for the fishery back to 10 - 20 June.

Charlie Bergmann said that 96% of the June landings in Cape May were *Illex.*

Dan Cohen wants all annual specifications to be frameworkable, especially ABC.

Mr. Freeman closed the hearing at 1955.

OCEAN CITY, MD - SEPTEMBER 9, 1998

Hearing Officer Mr. Ricks Savage called the hearing to order at 6:00 p.m. Others present were Mr. José Montanez and Ms. Valerie Whalon of the MAFMC staff who prepared the summary minutes. There were ten members of the public present.

Mr. Savage presented the opening remarks and opened the hearing for questions and comments on summer flounder, scup, and black sea bass amendment.

Mr. Joe O'Hara (MD Saltwater Sportfishing Association) gave comments on the summer flounder scup and black sea bass amendment. He opened by saying that the figures are not legible and the entire amendment does nothing to reduce mortality, because it doesn't have clout. He raised concerns with proposed conservation measures. He referred to page 68 where it says that SAV beds are designated as a habitat area of particular concern, but he wants to know what is going to be done to protect SAV. More specifically he is concerned with enforcement issues as they relate to protected areas. How will this be done? He used the state of Maryland as an example, they tried to protect SAV beds, but didn't have enough money to mark them. He stated that we will not be able protect SAV without some enforcement, because there is no clout to protect SAV. He strongly supports the effort to protect SAV, but wants to know what the point of having the definition is? What is going to do be done to protect SAV? He also referenced p. 104 where it states that beach nourishment should not be allowed when fish (summer flounder) are present. He says that it is not possible to abide by this because beaches can't be nourished the in the winter when it is stormy. He referenced p. 77 and would like to see the Council look towards compensatory mitigation to solve this problem. For example, put a percentage of the cost of a beach nourishment project into artificial reef construction. He disagrees with the statement on p. 149 that states that the minimum mesh provision in conjunction with the minimum fish size ensures that discards of sub-legal fish are minimized, and on p. 136 37% of the discards will be fish that could be brought to market, the Council should look at their own data, they are increasing discards by throwing 14" fish overboard. He disagrees with the 5th paragraph on p. 150 where it state the economy is not affected negatively by the recreational measure. He stated that they (recreational head boat fishermen) lost 2 weeks of the season in August (when they couldn't fish for black sea bass), it is an economic loss, and needs to be addressed. He disagrees with the statement on p. 152, he does not think that the species mentioned at the bottom of p. 152 has been graded for price, he thinks the council should look at using management measures combining quotas and trip limits. He disagrees with the last sentence on p. 154 that everything has been done to alleviate bycatch, and National Standard 9 is satisfied or has been met, and on p. 153 that a mesh reduction to 5 ½ in. will reduce discards. He does not think that the mesh regulations that changed in June 1998 helped in reducing summer flounder discards. The Council should be studying mesh selectivity to minimize discards. He said that lack of discard data has hampered the ability (of the Council and Commission) to respond to potential discard problems in the commercial fisheries. If this is true, then how can the Council say that National Standard 9 has been met. He agrees with the public education program on catch and release but how will it be implemented. On p.75 he feels that the following should be added to the frameworked provisions: management measures?......that affect EFH?... and measures for conservation and enhancement of EFH, sale of fish, and conservation equivalency by state. He said that comments were specifically requested on research recommendation and suggested the following research: length/frequency studies by statistical areas , net/mesh selectivity (he said we didn't do them before and now the nets are bought and it should have been done in the other order), area closures during summer flounder spawning, and bycatch for all three species.

Mr. Monty Hawkins, a recreation head boat owner stated that the black sea bass moratorium didn't kill his business because luckily the croaker showed up. We're lucky that black sea bass aren't totally collapsed. Scuba divers told him that the water temperature at the bottom is extremely cold (maybe that is why there are so few black sea bass?). He thinks that someone somewhere else had a good year with black sea bass. He feels that conservation measures for black sea bass are needed. He agrees with EFH and he hopes that part of the plan keeps moving forward.

Mr. Robert Gouar of Ocean City Fishing Center suggested that the Council needs a limit on black sea bass. He stated that the north didn't have black sea bass either. He went on to say that a closure is not as good as a limit. He said that the winter trips are where they (the north) are being carried, and they also need them (black sea bass) in May, but a limit is needed instead of a closure.

Mr. Savage called for comments and questions on the mackerel, squid, and butterfish amendment.

Mr. Monty Hawkins stated that since the Atlantic mackerel collapse in 1991, since joint ventures and it has been brutal ever since, from a hey day to how it is now where he can't get people here (to fish for them). The Council should let them rebuild.

Robert Gouar stated that they tried to have a factory trawler in Cape May last year, but it got knocked down.

Mr. Savage called for comments and questions on the surfclam and ocean quahog amendment.

Mr. Wally Gordon felt that some issues needed definition, for instance, "There was minimum short-term economic dislocation to whom?" (he feels his company was economically dislocated). He feels his company has been affected economically (adversely) by the Council's actions. He doesn't think the resource should be managed by economics within the industry itself, it should be managed for economic stabilization of the clam or any species where there is not a fresh market. Clams sitting at a dock without a processor are worth nothing. He would like to see the Council to get out from between the harvester and processor, to let them work together. He wants to see it managed from the point where the harvesters and processors can put the clams in the freezer or can and market it to the best of their ability. Managing for the of good of NJ is not for the good of all. The resource should be managed throughout the range of the species. He goes on to say that 70% of the surfclams haven't been from Ocean City, Maryland in the last 6 or 7 years. These clams need to be caught so they can be productive. The quota can't be based on what New Jersey is catching. He reiterates that clams need to be managed by area and something needs to be done to thin out the small clams in this area. Historically these clams have been as productive as the clams in New Jersey. They should be managed by area.

Mr. Bill Meadows stated the overfishing definition addresses only surfclams offshore of NJ although the management unit is the entire EEZ. The quota should reflect the desire to shift the fishing pressure. He supports the concept of not changing the quota at any time during the year, (either increase or decrease it).

Mr. Tom Alspach asked a question about the proposed overfishing definition, is the NNJ target area in which the overfishing definition is based on in equilibrium? He asked if NNJ becomes overfished, will the entire EEZ be closed? Mr. Alspach also wanted to know what NNJ is (e.g., geographic definition), he could not find a definition in the plan. Is Mr. Montanez replied that he didn't know and he would have Dr. Hoff answer those questions for him. He is concerned that the overfishing definition concept is being grossly misused to achieve a policy issue to keep fishing down in New Jersey. He also feels that prudent quotas at the current landings should be sustainable. If they want to address a problem in NNJ they should produce management measures in this area. The overfishing definition is an effort to undo a managed unit as a whole, it is not a proper way to apply a concept throughout the EEZ. He feels that to use NNJ as a target is a gross misuse of the concept of an overfishing definition.

Mr. Hawkins stated the he can't buy surfclams as bait and wanted to know what they do with the shells. Mr. Gordon replied that at Chincoteague they mix crushed shell with pine pitch for roads, and some places they market the shells for landscaping and driveways, however some places you have to pay to have them hauled away. Mr. Hawkins stated that it seems that the Artificial Reef programs could work out a deal where the costs of shipping surfclam shells for artificial reefs could be a tax write off. He hopes that the bottom area is assessed and it seems that the plan is moving in that direction. Mr. Savage and Mr. Gordon explained to Mr. Hawkins why he can't buy surfclams for bait.

Mr. Tom Alspach stated that under the current assessment, the production model showed that NNJ was at equilibrium or slightly positive. He asked if the model went to negative numbers does it mean NNJ is overfished and therefore the entire resource overfished, and how would that be affected by changing natural mortality.

Mr. Bill Meadows stated that the overfishing definition applied to specific definition assuming we had a definition that would be definite. He asked, if the overfishing definition was tied to a specific area and fishing pressure shifted to another area like Delmarva, could Delmarva area be harvested? Mr. Montanez stated that he didn't know and that he would have Dr. Hoff answer that question. He states that this is the kind of concern he has going to a specific area for an overfishing definition. He stated that an overfishing definition over the entire EEZ should be established. He thinks that the yield from the Delmarva area or region is lower, a strategy is needed or a management scheme to get harvesters to go to Delmarva. It will relieve a lot of pressure off of NNJ.

Mr. Wally Gordon stated that a processor has to encourage harvesters to go to NJ because of the ITQ system. The whole reason the clams are small is because the area was closed.

Mr. John Bundy from Miss Ocean City (party boat) stated that this year was one of the worse years for black sea bass. He doesn't know why. He thinks that the two week closure is very bad and hurt all the party boats in Ocean City. There needed to be enforcement and the marine police can't do it all. There are boats keeping less than 10 in. fish and no enforcement officers are around to enforce the laws. It took place during the busiest part of the season and he's really mad about it. There are better ways to limit catch. He would like to see the size limit stay at 10" and he would rather see a bag limit than a closure. He said he threw back 75% undersized fish and that still wasn't enough fish.

Mr. Hawkins said that boats were fishing in bad weather offshore for hake because of the closure.

The hearing was closed at 7:45 p.m.

Dear Senators Stevens, Chafee, Snowe, Kerry and the Atlantic Fisheries Council;

My name is Don Cameron and I've been a fisherman for the past 30 years. Fishing out of Gloucester, Boston, Virginia and Alaska. I've been everything from cook to captain. During the past 30 years I've endured storms on Georges Banks that I have been lucky enough to return to port; but many others haven't.

I can recall pulling along side the Capt. Cosmo and calling over to the crew that we were going in and that I would see them in a couple days. No one has ever seen them again! I lost a dozen friends on three different boats that fall. One night last year we had a crew of 7 friends over for supper on the Katie Ann in Seattle. They left to head for Alaska on their big safe boat and the next day the F/T Explorer found one body.

Please take the time to read the books the Perfect Storm, Working on the Edge or Nights of Ice...

Now let me get to the point. I'm a crew member on the Atlantic Star. In the 30 years of fishing I have never felt so totally safe on a vessel. I have made many trips on giant factory trawlers and many times with huge bags of fish on deck. Our stability left a lot to be desired and left a taste of fear in this old sea dogs mouth. I have no problem with the Stevens bill and the exclusion of factory trawlers from our waters. The Atlantic Star is not a factory trawler! We are a little big boat. There are many boats in the mackerel and herring industry that catch and hold more fish than we possibly could. We are a safe working platform. What has horsepower and length got to do with anything in regards to the Atlantic Star. The power pushes a large safe vessel that can only catch and process 250 tons of food quality fish a day.

You limit the size and horsepower to exclude the Atlantic Star and then people will invest in the conversion of round bottom mud boats that catch mackerel and herring offshore. You watch and see boats being lost because greedy skippers will overload their boats and get caught in unpredicted winter storms on Georges Banks. It's going to happen mark my words! And I hope every life that is lost on a boat that would be forced to work under a law like that remains on the conscience of lawmakers and people that support that law the rest of their lives.

I sincerely hope that I have a job along with 50 or more American fishermen and women on the East Coast.

Thank you,
Don Cameron
Atlantic Star

Don Cameron

9/8/98

ATTACHMENT 2

WE THE UNDERSIGNED ASK FOR THE IMMEDIATE RESIGNATION OR FIRING OF JIM O'MALLEY AS RHODE ISLAND'S REPRESENTATIVE TO THE MID ATLANTIC COUNCIL.

MICHAEL TARASEVICH F/V BLACK SHEEP
Brian Loftes F/V Elizabeth Anne
[illegible] F/V [illegible] Rose
Jon [illegible] O/A Mystic
William E [illegible] F/V Capt [illegible]
[illegible] [illegible]
[illegible] F/V [illegible]

WE ARE PROUD OF
FISHERMEN
UNITED NATIONAL FISHERMEN'S ASSOC.
919-473-3287
123 APPLE RD. MANNS HARBOR, N.C. 27953

Comments on Amendment 12 Summer Flounder Scup & Black Sea Bass

This Document Is not Based on best Scientific Information, it is based on flaws that started in the 1981 Fishery Management Plan for Summer Flounders Prepared by Paul G. Scarlett.

At the time Chang & Pecheco information was the best Science but was rejected due to the desire of the plan writers to implement stringent regulations on one sector of the fishery (commercial) this bias is reflected in the interpretation of the available information. If the corrected age (1996 information was inserted into the plan then the original plan would have started fishing on age 3 fish.
Faulty science is part of the 1987-88 Council fishery Management plan This plan also set Separate standards in 1993 quota vs. landing limits for Commercial & Recreational fishing a violation of the new Magnuson act. Amendment 12 does not Address recreational by - catch and hook and release mortality. (National Standard 9)A simple keep the first X fish and no releases in the recreational fishery would address the problem. Regulatory Waste due to quota management is not addressed in this plan the so called 15% by catch reduction is penalty to the commercial sector. No mention is made to address the increase in number of recreational fishermen that has lead to increased harvest and hook and release mortality. Amendment 12 does not reflect that declines in landing in scup and Black Sea bass were due to the 5 1/2 web size imposed in 1989 by N.C. and 1990 in the EEZ

1.1.2.1 the current overfishing definition is incorrect, nothing in the plan mentions natural cycles or explains the changes in landings that have occurred in recorded landing. (examples 18.6 tide cycles 10-12 year changes in sea temperature, Russell cycle, solar cycles, lunar tide occurrences.) as (msy) has varied in history then Page 8 (is expected to result in long -term average yield close to msy.) this statement can not be justified as msy has varied due to natural fluctuations.
Magnuson Steven's 101-627, 104-297 (3) to assure that the national fishery conservation and management program utilizes, and is based upon, the best scientific information available; involves, and is responsive to the needs of, interested and affected States and citizens; considers efficiency; draws upon Federal, State, and academic capabilities in carrying out research, administration, management, and enforcement; considers the effect of fishing on immature fish and encourages development of practical measures that minimize by catch and avoids unnecessary waste of fish; and is workable and effective.

Definition of overfishing of the three species can not be correct, The projected msy has never been documented in any of the fisheries. Flounder target bio mass 169 million pounds and 338 million pounds (no where in the records do these figures exist) The commercial industry Questions the science that defines over fishing without referencing natural fluctuations.

Using existing definitions optimum yield and maximum sustainable yield are exclusive of each other and the fishery will never produce to capacity. Clearly the 1981 document could have placed MSY at 44 million pounds the adverage reported commercial landings from 1980 to 1989 was 19.5 million pounds with no net restrictions thus the number of fish killed landing 19.5 million # would have been greater than landing 19.5 million using 5 1/2 web through out. Science never explains why the fish are in numbers and the quota is in pounds.
F .24 can not be justified as the stock has recovered with the industry fishing a much higher than proposed F. Council has not justified how in 1993 a separate system of allocation was put in place Quota for commercial with mandatory pay back and a harvest limit and no pay back, clearly this does not meet Magnuson requirements. The continued change in regulations on a yearly basis has not allowed for information on the effects of regulations to be evident. thus since 1989 no information on net size is available (this is inexcusable)

Essential fish habitat as addressed in this document is based on incorrect information. the effects of natural occurring cycles, changes in sea water temperature, acid rain , chlorine, and the affects of land development are far greater than the effects of fishing. This portion could be interpreted to prevent the further development or any recreational use of the marine environment. Again the interpretation of Essential fish habitat like over fishing should not be in the hands of those who will benefit from increased employment in application of the rules.

Commercial fishing sector of the industry has lost all faith in the management process and the ability of science to predict or management to increase production.

4.6.3 this action in combination with prior plans has had a > 5 % losss for 20% or more of the fishermen . thus an economic statement needs to be completed. the proposed EFH section will close all areas to fishing commercially with time.

APPENDIX 2. COMMENT LETTERS AND COUNCIL RESPONSE

A total of nine comment letters were received by the Council on the hearing draft of Amendment 12 for Surfclams/Ocean Quahogs. Three letters represented fishermen; one letter came from a commercial fishing organization; one letter was from a national agency, and two letters represented miscellaneous interested parties. Two letters were also received from state agencies, which the Council requested.

Comment 1: Four respondents felt that it is not appropriate to use only data from Northern New Jersey for stock assessments of surfclams. If that area becomes overfished, the entire EEZ must then be closed, regardless of the status of the stock in other areas of the coast. Conversely, if that area is not overfished, the fishery would remain open and could result in almost all of the remaining clams on the coast being taken.

In general, there is somewhat of a misconception about the new overfishing definitions. Overfishing does not occur unless the fishing mortality threshold ($F_{20\%msp}$) is exceeded and the surfclam resource is not overfished unless the biomass is reduced to below one-half the B_{msy} level. The surfclam fishing mortality threshold ($F_{20\%msp}$) is the same estimate that was implemented by the Council with Amendment 9 in 1996 and is more than four times higher than the current fishing mortality estimate (0.04) for the Northern New Jersey region. The recent SARCs for surfclams (NEFSC 1998a) and for ocean quahogs (NEFSC 1998b) did not provide overfishing definitions for surfclams. However, several individual NEFSC scientists, working with MAFMC staff, developed an overfishing definition for the biomass portion of the definition by using the Northern New Jersey area as a proxy for B_{msy}. Several lines of evidence suggest that the 1997 biomass estimate for Northern New Jersey (NNJ) is a reasonable proxy for B_{MSY}, and that the annual production from that region is a reasonable proxy for MSY. These include:

- Annual production of biomass by surfclams in the NNJ region, where 80% of the landings are typically taken, is roughly equivalent to the annual EEZ quota.
- About 80% of commercial EEZ landings are typically taken from the NNJ region. While being exploited, mean shell length in this region has remained stable since 1985.
- Landings per unit effort (LPUE) by large vessels in the NNJ region have declined slightly since 1991, but have remained stable for the last four years (1994-97) at 1,650 - 1,750 pounds of meat/hr fished.
- Annual recruitment has occurred repeatedly in the NNJ region where the fishery has been prosecuted. This is reflected by the large number of year classes in the stock in 1997.

These lines of evidence suggest that present harvests from this region are sustainable, at least for the next few years.

The critical aspect of the overfishing definition is that it is sustainable for several more years which will allow NEFSC to conduct more clam surveys (1999 and 2001) and thus will provide at least two more assessments that are as thorough as those produced from the 1997 survey. New survey technology and assessment approaches (NEFSC 1998a and 1998b) provided state-of-the-art analyzes, however these changes precluded direct comparisons with previous surveys. From the latest SARC (NEFSC 1998a) surfclams are "probably under-exploited overall", and thus there is practically no threat of overfishing in the immediate future.

Concern has been expressed by several industry members both in written comments and at the public hearings that if the overfishing definition is based only on the Northern New Jersey area (which has about 36% of the overall resource) and the natural mortality estimate for surfclams is changed in the next assessment, it is possible that with the current modeling of the short-term projections, the productivity of the Northern New Jersey area may become negative as opposed to being near equilibrium. Assuming that these assumptions on the behavior of the model are correct, a short-term negative production estimate for Northern New Jersey would not result in the resource being declared overfished or for overfishing to occur. Both of those situations would result only if the threshold biomass figure or threshold fishing mortality rate were surpassed.

Finally the "proxy" nature of using Northern New Jersey needs to be emphasized. The definition uses the best science from the most recent surfclam assessment, but as new assessment information becomes available (after the 1999 and 2001 surveys), any better information will be used, and in fact, it is seriously desired that true B_{msy} and F_{msy} estimates can replace the proxy, and thus should not require an Amendment. However, if an Amendment is necessary the entire overfishing definition is frameworked and thus could quickly be changed without major impact to industry or the resource.

In summary, the current data are insufficient to accurately estimate B_{MSY}, MSY, or F_{MSY}. However, stable yields, absence of change in mean length, successful recruitment, and the rough equivalence of production in NNJ with harvests, imply that the current policy is at equilibrium with the resource and may be near the optimum. Finally, we note that there is consistency between the current recommendation and earlier modeling results by Murawski and Idoine (1989). Their simulation model of surfclams under exploitation, which incorporated numerous population parameters including variability in recruitment among years, indicated that a constant-catch policy of 45 to 55 million pounds/yr would achieve a balance between yield maximization, low interannual variation in yield, and risk-aversion.

As further justification of the sustainable nature of the resource with these harvest levels, the estimate of MSY in the original FMP was 2.9 million bu. (approximately 50 million pounds of shucked meats) over the range of the resource, which was based on commercial landings from 1960-1976 (MAFMC 1977). In Amendment 8 (MAFMC 1988) the MSY section concludes, after extensive modeling by the NEFSC, that: "In terms of the overall MSY, it appears that the previous estimate of 50 million lbs of shucked clam meats everywhere, is probably the best current estimate for the mid-Atlantic EEZ surfclam population."

In conclusion, the new overfishing definition "target" for surfclams will be the 1997 biomass estimate for Northern New Jersey (NNJ) as a reasonable proxy for B_{MSY} and the associated F_{PO} (production replacement) level of fishing mortality that would result from an annual catch equal to the annual production of biomass by that NNJ region. The overfishing definition "threshold" would be ½ the B_{MSY} proxy (as recommended by the Applegate *et al.* 1998 Overfishing Definition Review Panel report) with an $F_{20\%}$ level of fishing mortality that should never be exceeded. The $F_{20\%}$ MSP level is the threshold level recommended by the NEFSC for Amendment 9 (MAFMC 1996) and reviewed and approved by the MAFMC Scientific and Statistical Committee.

Comment 2: One commenter stated that the Amendment overstates the damage caused by clam gear to the habitat, especially since the ITQ system has been in place. Clamming is done efficiently and carefully, thus making as little disturbance to the habitat as possible.

The Council is not proposing any management measures of fishing gear because of essential fish habitat at this time. From Auster and Langton (1998) we know that hydraulic clam dredges damage buried bivalves when the dredge does not fully penetrate the bottom to a depth below the horizon where clams occur (Meyer *et al.* 1981). The cutting bar directly breaks clam valves from the force of the dredge moving laterally through the sediments and pushing against high densities of clams. In all studies, the authors made reasonable assumptions regarding levels of damage which will result in direct mortality (e.g., broken hinge, removal of a valve, exposure of soft tissues). However, no studies followed individuals to assess long term mortalities based on damage such as chipped shell margins, which may increase the risk of predation from crustacean predators. The issue of mortality associated with catching but not landing is included in each of the recent stock assessments for surfclams (NEFSC 1998a) and ocean quahogs (NEFSC 1998b).

The surfclam and ocean quahog fisheries are ITQ fisheries, and as such there is no reason that fishermen have a "rush to fish". One of the great benefits of ITQ fisheries from around the world is that it instills the sense of private property rights and ownership in the resource. Fishermen in these fisheries understand that they are not time driven to rape the resource and that by protecting the resource and its environment they are protecting their long term livelihoods. Unquestionably, ITQs and the way clams are now fished alleviate some environmental damage.

With the above limited gear impact statements (Auster and Langton 1998), the minimal bottom impact of only 50 vessels, and statements of internationally known invertebrate experts (Drs. Roger Mann of VIMS and Eric Powell of Rutgers who state that the bottom is stirred up more from the average Northeaster than from surfclam dredging) the Council believes that no specific management measures should be proposed for this fishery at this time.

Comment 3: One commenter said that the damage done to the habitat by dredges is more than the damage done by pots.

The Council is not proposing any management measures of fishing gear because of essential fish habitat at this time. The Council agrees that fish pots would have less of an impact to surfclam or ocean quahog essential fish habitat which is generally sandy, fairly uniform, level bottom.

Comment 4: One respondent stated that the framework adjustment procedure will not give fisherman enough time to plan for the changes or find other sources of income.

The Council agrees to some extent with this comment and has restricted the framework adjustment procedure for this fishery for many issues. Essential fish habitat, HAPCs, overfishing definitions (both the thresholds and targets), OY range specification, implementation of VTS, and set aside quota for scientific research are the only items that are frameworked.

Comment 5: One respondent felt that the framework provision is unnecessary with the ITQ system in place, which gives the Council more immediate and flexible control of the fisheries.

The Council agrees to some extent and has modified the framework adjustment procedure for this fishery to all but the few issues identified in comment 5.

Comment 6: One commenter stated that the overfishing definitions for surfclams and ocean quahogs are inaccurate.

The issue of the overfishing definition for surfclams is addressed in the response to comment 1 above. The overfishing definition for ocean quahogs was developed through the Invertebrate Subcommittee (comprised of NEFSC scientists, Council staff, academics, and industry), presented and approved by the SARC and likely is as thoroughly peer reviewed as any overfishing definition in the country.

Comment 7: One respondent felt that the dumping of fisheries waste at sea should not be strictly regulated or prohibited. It was pointed out that this practice is legal in the Federal Zone, and that with careful dumping, it has never been and will not become a problem.

The Council is not proposing to strictly regulate or prohibit disposal of fish waste at sea. The recommendation is: "Ocean disposal of fresh fish waste (i.e., scallop shells and bodies, fish racks, etc.) shall be permitted in areas that are not environmentally at risk. Monitoring of the disposal area will be the responsibility of the discharger if there is credible scientific information that suggests the area is being negatively impacted by the discharge."

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

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

Comment 8: Two respondents stated that EFH for waters around Massachusetts should be modified and expanded.

EFH now includes any ten-minute squares that were identified as such on the blank maps that were in the FMP. Comments from individuals that identified EFH in general terms or without any documentation will be supplied to the Habitat Monitoring Committee for their future consideration. It is anticipated that as the various state surveys are compiled in a uniform format by the NEFSC researchers at the Howard Laboratory at Sandy Hook the Habitat Monitoring Committee will be reviewing and perhaps recommending new identification and description of EFH.

Comment 9: One commenter felt that the Amendment is too broad and oversteps the authority congressionally granted to NMFS and the Councils, especially regarding: (a) the EFH definitions which go beyond waters that are "essential" and "necessary" to the species as intended by the Magnuson-Stevens Act and the SFA; (b) that NMFS and the Council have authority to manage fisheries only, and the Amendment transgresses that authority by including non-fishery related measures; and © that NMFS and the Council have no authority to extend EFH or any management measures to state managed, inland waters, and that the Amendment should not attempt to include those areas.

The Council disagrees with this commenter's beliefs that this Amendment represents a clear departure from the letter of the MSFCMA and the intent of Congress. The Congressional mandate was clear and NMFS has interpreted that mandate and proposed regulations. During the comment period on the EFH regulations, these types of comments should have been raised. Many similar issues were raised during the comment period on the proposed regulations and were addressed by NMFS. The Council is simply working within the NMFS EFH regulations in the identification and description of EFH. Clearly the Congress wanted the NMFS and Councils to have authority of EFH and not simply propagate rules that reduce fishing mortality only.

Comment 10: One respondent stated that the section on Silviculture NPS (section 2.2.5.3.3) does not contain a balanced presentation of data and does not show in what way silviculture activities affect surfclams or ocean quahogs EFH. Specific objections cover the following points: (a) many of the conservation measures in this section are included in state BMP (best management practices) manuals and do not need to be restated with slight variations in the Amendment; (b) guidelines on road construction have no baselines and are too vague; © the statements regarding harvesting contain no objective guidelines or standards; (d) that the Amendment cannot enforce water quality standards and should instead defer to the existing guidelines in state programs; and (e) that the comments regarding restoration of upland habitat are too vague and not within the intended jurisdiction of EFH.

The Council agrees completely with this commenter's premise that best management practices should be used for all silvicultural NPS issues. All of the description and discussion of silvicultural problems were taken from NMFS (USDC 1997a) and EPA (USEPA 1993) documents. The Council is not proposing any recommendations that are not BMPs as considered by EPA in their *Guidance Specifying Management Measures for Sources on Nonpoint Pollution in Coastal Waters*. The series of recommendations that were attributed to Murphy (1995) have been dropped since they were somewhat duplicative of the EPA recommendations.

Comment 11: One respondent suggested that the 10 minute squares be adjusted so that quadrants not designated as EFH, but surrounded by others that are so designated, be included in EFH.

The designation of EFH now includes any ten-minute squares that were identified as such on the blank maps that were in the FMP as well as all ten-minute squares identified by the various federal surveys that meet the selection criteria . Comments from individuals that identified EFH in general terms or without any documentation will be supplied to the Habitat Monitoring Committee for their consideration. It is anticipated that as the various state surveys are compiled in a uniform format by the researchers at the Howard Laboratory at Sandy Hook the Habitat Monitoring Committee will be reviewing and perhaps recommending new identification and description of EFH. The identification of all ten-minute squares as EFH required data documentation for this initial process.

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

September 4, 1998

Christopher M. Moore, Ph.D.
Acting Executive Director
Mid-Atlantic Fishery Management Council
Room 2115 Federal Building
300 South New Street
Dover, DE 19904-6790

Dear Dr. Moore:

Enclosed please find the National Marine Fisheries Service's draft recommendations to the Mid-Atlantic Fishery Management Council regarding essential fish habitat (EFH) for summer flounder, scup, black sea bass, surf clams, ocean quahogs, Atlantic mackerel, *Lolligo* and *Illex* squid, and butterfish. Section 305(b)(1)(B) of the Magnuson-Stevens Act requires the Secretary of Commerce to provide recommendations and information to the Council regarding the identification of EFH, threats to EFH, and conservation and enhancement measures to protect EFH. The interim final rule for EFH, 50 CFR 600.815(c), requires NMFS to make its draft EFH recommendations available for public review prior to submitting final EFH recommendations to the Council. To facilitate this public review, I request that you make our recommendations available at the Council's public hearings on the fishery management plan amendments scheduled for September 8-9, 1998. NMFS will provide the Council with final EFH recommendations shortly after the public hearings are complete.

NMFS has also revised tables of the life history and habitat parameters for several of the species, which we will transmit to your staff under separate cover along with technical corrections and editorial suggestions on the EFH information for these species.

As you know, the Congressionally mandated schedule for developing EFH sections of fishery management plans was extremely short. With these initial EFH designations the Council has made a solid start at identifying EFH and potential threats. We look forward to working with you to build upon this work in the coming months. Should you have any questions about our draft EFH recommendations, please contact Jon Kurland of my staff at 978-281-9204.

Sincerely,

Jon C. Rittgers
Acting Regional Administrator

Enclosure

National Marine Fisheries Service Draft Essential Fish Habitat Recommendations to the Mid-Atlantic Fishery Management Council for Summer Flounder, Scup, Black Sea Bass, Surf Clams, Ocean Quahogs, Atlantic Mackerel, *Loligo* and *Illex* Squid, and Butterfish

Background

Section 305(b)(1)(B) of the Magnuson-Stevens Fishery Conservation and Management Act requires the Secretary of Commerce to provide recommendations and information to the Council regarding the identification of essential fish habitat (EFH), threats to EFH, and conservation and enhancement measures to protect EFH. The National Marine Fisheries Service (NMFS) has provided substantial background information to assist in the development of the EFH portion of the fishery management plans (FMPs) for summer flounder, scup, and black sea bass; surf clams and ocean quahogs; and Atlantic mackerel, *Loligo* and *Illex* squid, and butterfish. NMFS prepared a synthesis report of the life history and habitat requirements of each species, which reviews the relevant scientific literature and includes summaries of data on the species' distribution and relative abundance. NMFS also prepared maps and graphs showing the distribution and relative abundance for each major life history stage, and analyzed these data by ranked ten minute squares of latitude and longitude to show the areas that yielded the highest catches per unit of sampling effort. Additionally, NMFS provided the Council with maps of the relative abundance of most of these species in estuaries, based on NOAA's Estuarine Living Marine Resources data set. During numerous meetings, NMFS staff discussed these information sources with Council staff and the Council's Habitat Committee and offered guidance and assistance in the designation of EFH.

To supplement the above information, NMFS prepared the following draft EFH recommendations based on a review of the August 21, 1998 public hearing drafts of Amendment 12 to the Summer Flounder, Scup, and Black Sea Bass FMP; Amendment 12 to the Surf Clam and Ocean Quahog FMP; and Amendment 8 to the Atlantic Mackerel, Squid, and Butterfish FMP. The recommendations are organized into four separate sections: one for issues that apply to all three FMPs and one for additional specific comments on each of the three FMPs individually.

Recommendations that Apply to All Three FMP Amendments

1. Clarify the description and identification of EFH so users of this information can determine the geographic limits of EFH designations.

   (a) The maps of EFH in offshore areas are extremely difficult to read and understand. The final amendments should use larger format maps (e.g., one map per page instead of four for the preferred alternatives) and should include captions that explain that the shaded 10-minute squares are EFH. Also, the final maps should not show any EFH in waters beyond the U.S. exclusive economic zone.

(b) Since the Council is designating EFH in estuaries based on the relative abundance of the animals within the three salinity zones (seawater, mixing, and freshwater) used in the Estuarine Living Marine Resources data set, the final amendments should include maps of the salinity zones for each estuary. These maps are available from NMFS if the Council does not have them already. This information is necessary so that readers can understand the delineation of EFH in estuaries.

(c) If the maps identifying EFH and the text description of EFH differ, the text description is ultimately determinative of the limits of EFH (50 CFR Part 600.815(a)(2)(iii)). Therefore, to avoid any such inconsistencies, the text descriptions of EFH in the final amendments should reference and incorporate the tables and maps of estuaries that are considered EFH, as well as the maps of offshore areas that are considered EFH.

(d) The text descriptions of EFH north of Cape Hatteras should be modified to reflect that EFH is those areas that support the highest density or relative abundance of the managed species, as indicated by the highest X% of catch per unit effort based on an analysis of available survey data. Some of the EFH designations reflect a percentage of area (e.g., a 90% designation represents the top 90% of all the ranked squares) and some reflect a percentage of catch (e.g., a 90% designation represents the highest ranked 10-minute squares that comprise 90% of the catch), but both methods of EFH designation are premised on the assumption that high relative abundance indicates high value habitat. As currently written, it is not clear what the percentages in the EFH descriptions represent.

(e) In all three draft amendments, the first paragraph in Section 2.2.2.2 (i.e., the paragraph immediately preceding the text description of EFH) provides a brief narrative that explains the "general" characteristics of EFH for the managed species. This portion of the documents is confusing because it contains an incomplete summary of the written descriptions of EFH that appear below it. It also conflicts with the text descriptions of EFH by stating that the portions of the EFH designations that are based on the survey data are limited to "those areas in federal waters" that meet certain specifications, whereas the survey data and supporting maps include many areas in nearshore state waters. This paragraph should be deleted from the final amendments to avoid confusion over which section is the correct description of the limits of EFH.

2. Refine the discussion of the methodology used to designate EFH.

(a) Sections 2.2.2.1.2 and 2.2.2.1.3 of all three draft amendments discuss options for designating EFH based on the "objective criteria" approach. This approach appears objective because it uses numeric cutoffs, but actually it is subjective for two reasons: 1) the cutoffs could well have been 40%, 60%, 80%, and 100% rather than 50%, 75%, 90%, and 100%, and 2) the choice of one particular cutoff for designating EFH is based on the best professional judgements of the people involved; there is no *a priori* reason to choose 50% over 75%, or 90% over 50%. The final amendments should clarify that these thresholds were subjective, but they reflect a reasonable range of designation alternatives.

(b) Section 2.2.2.1.3 of the draft amendments states that "The Level 2 data that are summarized in the ten minute square maps came from the MARMAP ichthyoplankton and/or NEFSC trawl survey. Data were assigned to a ten minute square based on the location of the dredge tow sample. Only those squares that had more than four samples and one positive catch were selected." The last sentence of this passage should read "Only those squares that had more than three samples and one positive catch..." The words "dredge tow" should be deleted since the samples from the various data sets involved dredge tows for the bivalves, trawl tows for fish, and bongo nets for ichthyoplankton.

(c) In the discussion of limitations in Section 2.2.2.1.3, the text states that "The NEFSC trawl survey does not survey everywhere...and thus this analyzes (sic) is constrained and significantly biased low." In fact, it is plausible that the area occupied by the species could be significantly overestimated (i.e., biased high) by the 10-minute square analysis. For example, if the species only occurred at depths of 10-75 m, the 10-minute squares where the species occurred could contain a high proportion of area >75 m deep. The NEFSC survey does not sample everywhere, but once the data are cast into 10-minute squares, without further analyses we do not know if there is bias or its direction.

(d) The same section (2.2.2.1.3) of the draft amendments states that the Council's selected approach for designating EFH is "fraught with limitations and based on major assumptions." While it is appropriate to acknowledge the shortcomings of the selected approach, the final amendments should emphasize that this methodology was adopted by the Council because the Council (presumably) determined that it was the best technique available, despite the limitations. Also, the statement that "None of the [state] surveys collect the habitat information that is most needed (habitat type, substrate...)" is not accurate. For example, the Long Island Sound survey has substrate maps.

3. <u>Revise the discussions of threats from fishing and non-fishing activities to be more specific to the species addressed in each FMP.</u>

(a) The discussion of fishing-related threats in Section 2.2.3 of the draft amendments borrows extensively from the Auster & Langton report, but without tailoring the Auster & Langton text to make it pertinent to the species or gears used in these fisheries. It would be far more effective for the discussion of fishing-related threats in each amendment to focus on the fishing activities that may affect the species in the fishery management unit, as well as the gears used in the fishery that is covered by the FMP. For instance, most of the discussion in Section 2.2.3 of the draft surf clam and ocean quahog amendment does not relate directly to the habitat of those species.

(b) The discussion of non-fishing threats and associated conservation and enhancement measures in Section 2.2.5 of the draft amendments lists a variety of concerns, but most of these are generalized and do not apply specifically to the EFH of species covered in each FMP. The final amendments should highlight the connection between the identified threats and their effect on the managed species' EFH. The documents should explain the relevance of the threat to the managed species and discuss how the suggested conservation measures benefit the managed species. For example, dam construction for reservoir development is not a threat for surf clams or ocean quahogs (Section 2.2.5.2.1), nor are hydropower plants (Section 2.2.5.5.1). The recommendation to avoid dredging or dredge spoil placement in submerged aquatic vegetation appears in the draft mackerel, squid, and butterfish amendment (Section 2.2.5.4) despite the assertion earlier in the document that these species have no strong association to that habitat type (Section 2.2.3.8). The recommendation for the fishing industry to familiarize itself with the potential of sea level rise (Section 2.2.5.14.5) is not germane to EFH at all. Section 2.2.5 of all three amendments should be substantially edited and revised to be more relevant to the species managed in each FMP.

4. The amendments should explain how they meet the requirement to minimize to the extent practicable the adverse effects of fishing on EFH.

(a) The draft amendments do not explain how they address the Sustainable Fisheries Act requirement to minimize the effects of fishing on EFH to the extent practicable. Section 2.2.4 of all three draft amendments states that all mobile gear coming into contact with the sea floor has a potential impact on EFH, but the amount of fishing effort is unquantified "and therefore no management measures will be proposed at this time." However, according to 50 CFR Part 600.815(a)(3)(iii), "Councils must act to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable, if there is evidence that a fishing practice is having an identifiable adverse effect on EFH..."

(b) The final amendments should specifically address whether fishing activities are having an identifiable adverse effect, and if so, what management measures serve to alleviate the impacts. For example, for EFH for adult mackerel, squid, and butterfish, it may be reasonable to conclude that gear management measures are unwarranted because the species are pelagic and do not exhibit strong associations to physical habitat features, but *Loligo* eggs are laid on the bottom in clusters, so Section 2.2.3.8 should indicate whether they may be affected by bottom-tending fishing gear. For surf clams and quahogs, information in Section 2.2.3.8 indicates that hydraulic clam dredges may affect EFH, but Section 2.2.4 does not discuss any existing or proposed management measures that address these effects. Likewise, Section 2.2.4 of the draft summer flounder, scup, and black sea bass amendment does not describe measures to minimize the effects of fishing on EFH, even though Section 2.2.3 discusses potential threats to EFH from fishing. Although submerged aquatic vegetation is proposed as a Habitat Area of Particular Concern (HAPC) for summer flounder, the draft amendment does not discuss impacts to seagrass from fishing gear.

(c) All three of the final amendments should include a discussion of options for managing the effects of fishing on EFH, including existing management measures that limit effort and may indirectly protect habitat. The final amendments should also explain the strategy and approach the Council intends to use to address this issue over time. The Council is only required to adopt management measures that are practicable, based on the criteria in 50 CFR Part 600.815(a)(3)(iv), but the draft amendments do not indicate whether the Council has determined that existing measures are the only steps that are currently practicable.

5. The amendments should explain why the Council is not proposing to designate any areas as HAPC for most of the species. Section 2.2.2.1 of the three draft amendments states that the Council is not recommending any areas as HAPC at this time (except for summer flounder), but does not provide a rationale. The final amendment should explain why (e.g., if the Council determined that available information for the species is inadequate to justify HAPC designations).

6. The framework adjustment process should include HAPC. The list of management measures that could be implemented or modified through framework adjustment procedures (Section 3.1.1) should include the designation of HAPC, which would give the Council flexibility to establish or modify HAPC designations as supporting information becomes available.

7. The final version of the amendments should be edited thoroughly. Despite the limited amount of time available to comply with the Sustainable Fisheries Act requirements, the Council has amassed a tremendous amount of information in the EFH sections of the draft amendments and has made a solid start at identifying EFH and potential threats. The final amendments could be strengthened considerably by editing the EFH sections to remove superfluous material, correct typographical errors, and clarify the tables and figures. As noted above, some of the material in the non-fishing threats sections (2.2.5) is not germane to the species managed by each FMP, and the maps of offshore EFH for all species are very difficult to read. Also, the lists of EFH research recommendations in Section 2.2.7 are too exhaustive and could be shortened by excluding items such as Stock Assessment Review Committee research recommendations that have very little to do with habitat, even indirectly.

Recommendations on EFH for the Summer Flounder, Scup, and Black Sea Bass FMP

1. Refine and clarify the EFH designations for summer flounder.

   (a) The text description of summer flounder EFH south of Cape Hatteras should be improved by refining the geographic references. For example, the southern boundary for EFH south of Cape Hatteras should be more specific by using a geographic reference point such as Cape Canaveral rather than describing the southern limit of EFH as "Florida."

   (b) Page 27, 2nd paragraph, notes information regarding adult distribution based upon bottom temperatures from Smith (1973). This type of information should be used in Section 2.2.2.2 to narrow the EFH designation offshore, rather than designating the entire exclusive economic zone as EFH.

(c) Since eggs are part of the neuston, the methodology for designating EFH for eggs south of Cape Hatteras (i.e., using the depth of water at which eggs are found north of Cape Hatteras as a surrogate for egg distribution south of Cape Hatteras) should be refined. Distribution is much more likely to be based on water currents or location of spawning adults. Depth would be more defensible if used as a surrogate for distance offshore.

(d) Limiting the designation of EFH seasonally is biologically defensible, but it interjects difficulties for the consultation process since federal agency actions might not be subject to the consultation requirements if they occur during a season not specified as EFH. The final amendment should eliminate the seasonal aspect of EFH, which would allow NMFS to consult with federal agencies on any actions that may adversely affect the habitat.

(e) The designation of EFH south of Cape Hatteras should be narrowed using the description of habitat parameters given in the amendment text and/or consultation with summer flounder experts, SEAMAP reports, and related information, rather than considering the entire continental shelf to be EFH. Since larvae move into estuaries, inlets to estuaries designated as EFH should be considered EFH as well. Juveniles are said to accompany adults offshore during seasonal migration, so these two designations could be linked. The reference to continental shelf waters between salinities of 10-30 ppt is confusing since most continental shelf waters have a salinity greater than 30 ppt.

(f) The identification of HAPC for summer flounder is appropriate. Additional support for this designation comes from Malloy & Targett (1994 a&b) who conclude that prey availability is very important to the growth and condition of early juveniles during the months immediately following settlement. However, the HAPC designation should be more specific. Unfortunately all SAVs have not been mapped, but the text description could be clarified by stating whether the HAPC designation applies to all species of SAV, whether it includes beds of all sizes, etc.

2. Refine and clarify the EFH designations for scup.

(a) Only estuaries are designated as EFH for the egg and larval life stages of scup. If possible, information from the literature for spawning adults should be used to add to that available for egg and larvae distribution in order to identify important nearshore areas as well.

(b) The terms "North of Cape Hatteras" for the juvenile and adult EFH designations should be reconciled with the figures for EFH, which show shaded squares south of Cape Hatteras.

3. Refine and clarify the EFH designations for black sea bass.

(a) The information given in amendment text and figures depicting egg distribution presents a sound basis for EFH designation in nearshore coastal waters. The EFH description for eggs currently includes only limited estuarine areas, but it may be appropriate to include nearshore areas as well.

(b) General descriptions of habitat preference including bottom type, temperature, and seasonal distribution should come at the end of the text description of EFH.

Recommendations on EFH for the Surf Clam and Ocean Quahog FMP

1. Consider designating EFH in state waters. Section 2.2.1.3 describes "critical" habitat for surf clams and quahogs in state waters off Massachusetts, Rhode Island, New York, New Jersey, and Delaware, based on the expert opinion of state biologists. However, the Estuarine Living Marine Resources Data set does not include data on surf clams or ocean quahogs, and Section 2.2.2.1 of the draft amendment states that the Council is not designating EFH in state waters because the management unit covers the exclusive economic zone only. The maps of EFH for pre-recruits and recruits of both surf clams (Figure 16) and quahogs (Figure 17) show numerous 10-minute squares adjacent to the coast that fall within the selected 90% alternative. Given that the survey data show high relative abundances of surf clams and quahogs in certain state waters, and the observations of state biologists confirm those data, it appears that the Council has ample justification to designate EFH in inshore areas. Designating EFH in state waters would also be consistent with the Council's decision to use "a more inclusive approach" to EFH designation in offshore areas "in an effort to be risk averse" (Section 2.2.2.1.3, p.39).

2. Consider designating EFH in the Gulf of Maine. Section 2.2.2.2 states that the Council is not designating EFH in the Gulf of Maine in the area of the small artisanal quahog fishery that occurs there because the Northeast Fisheries Science Center clam survey covered the area just twice in the early 1990s. Although no data exist to map even the presence or absence of the resource reliably (i.e., there is "Level 0" data), the habitat supports a resource that sustains a small fishery. If possible, it would seem worthwhile to attempt to identify valuable habitat areas through discussions with the fishing industry to designate EFH in the Gulf of Maine, rather than neglecting this area.

3. Revise the text descriptions of EFH. Section 2.2.2.2 should be revised to clarify that the description of EFH "throughout the substrate to a depth of three feet within federal waters" refers to depth below the ocean bottom, and not below the water surface. Also, if the Council decides to designate EFH in inshore waters, the text descriptions of EFH should be revised accordingly by dropping the words "within federal waters" and "throughout the Atlantic EEZ."

Recommendations on EFH for the Atlantic Mackerel, Squid, and Butterfish FMP

1. Clarify the terminology used to describe the life stages of *Loligo* and *Illex*. The use of the terms "pre-recruits" and "recruits" is an operational definition used by the Northeast

Fisheries Science Center referring to the size of individuals taken by the fishery, as opposed to the terms "juveniles" and "adults" which refer to attainment of sexual maturity. The maps and the discussion of distribution are based on the pre-recruit/recruit distinction, whereas the life history and habitat characteristics sections generally make use of the terms juveniles and adults, as discussed in the literature. This explanation should be included in the FMP text, possibly at the end of the "Habitat Requirements by Life History Stage" sections (2.2.1.2.3 and 2.2.1.3.3).

FAX TRANSMISSION

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To: Tom Hoff
Fax #: 302-674-5399
From: Arthur J. Newell
Subject: EFH in FMP's
Date: September 16, 1998
Pages: 1, including this cover sheet.

Tom, here are comments on the EFH sections in three of the four FMP's you sent me. John Mason is looking at the dogfish FMP, and we'll get any comments to you on that one next week.

Summer flounder, scup and black sea bass

Summer flounder - All inshore waters of NY are important summer flounder habitat with the south shore bays, New York Harbor, near shore ocean waters, all bays between the north and south forks of Long Island and Block Island sound being especially important. (Note: In many of the FMP's Great South Bay is listed as a NY estuary with EFH. "Great South Bay" should be changed in all FMP to read as the "South Shore Bay Complex" which extends from the Hempstead Bays in the west to Shinnecock Bay in the east; this includes Great South Bay.)
Scup are found throughout NY marine waters with large concentrations found around eastern Long Island (eastern Long Island Sound, Gardiners Bay, Peconic Bays and near shore waters around Montauk).
Black sea bass are found in eastern Long Island waters of Gardiners Bay, around Montauk Point and the major inlets along the south shore of Long Island. Likewise, they are found associated with hard structure in the near ocean waters off Long Island.

Atlantic mackerel, squid and butterfish

In Tables 13 and 14 Gardiners Bay should be changed to Gardiners/Peconics Bays. Also, the note above regarding the LI South Shore Bay Complex applies here, too.

Surf clams and ocean quahogs

On p. 35 there is a reference to a pers. comm with Fox. Dick Fox informed me that it should be clarified that "inshore waters" does not include the bays. Maybe it should read "all waters of the Atlantic Ocean and Long Island Sound under New York State control."
On p. 50 reference is made to vessels that shuck at sea. Dick Fox also informed me that he doesn't think there is any surf clam or ocean quahog shucking at sea.

cc: B. Young, D. Fox, J. Mason

FAX

Massachusetts Division of Marine Fisheries

Date September 1, 1998

TO: Tom Hoff

Phone:

Fax 302 674 5399

Arnie Howe
Mass Division of Marine Fisheries
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Phone (508) 563-1779 (ext. 105)

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Message:

21 pages

Number of pages including cover sheet

The Commonwealth of Massachusetts

Division of Marine Fisheries
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PHILIP G. COATES
DIRECTOR

August 31, 1998

Mr. Tom Hoff
Mid-Atlantic Fishery Management Council
300 South New Street
Dover, Delaware 19904-6790

Dear Tom:

Seasonal work priorities and the requested short turn around time on the four amendment documents (nine species) have not permitted me to review all the material in the EFH sections as I would have liked; accordingly, I have mostly confined my comments to sections on 'Importance in State waters' and 'Description and Identification of Essential Fish Habitat'.

For all the habitat section documents, except Surfclams/ Ocean Quahog, I strongly object to the rote language describing availability of MDMF data, e.g. 2nd paragraph on p. 49 of the Summer Flounder/Scup/Black Sea Bass Amendment. Because of that wording, I think it is a sham for me to comment on these sections when Massachusetts Inshore Trawl Survey data was available to the people charged with writing these amendments. Contrary to the statement in your letter, I have not been working with Stu Wilk; he and his colleagues have had our data from the very beginning of this process. Because of my involvement with the NEFMC EFH Tech. Team, I had presumed MDMF data was being similarly used by the Sandy Hook people for the benefit of the MAFMC, as it has been for the NEFMC.

I don't understand why NMFS Sandy Hook Laboratory personnel can utilize the MDMF inshore survey data to help the NEFMC identify 'preferred EFH habitat', yet the MAFMC didn't ask or receive it? I think it was a poor decision to exclude valuable survey information "because other states' data are not currently available in a format that makes it possible to compare them". If that is the rationale that has been conjured up, then by my reasoning R.I., Conn., and N.J. surveys may never be used for identifying EFH since none of those surveys are similarly timed, use the same vessel, gear, methodology, etc. or are in the same computer format as MDMF and NEFSC/NMFS.

The rote paragraph contains the following intellectually dishonest statement: "Therefore, these data [the state's data] will only be used to confirm ELMR data. These data generally agree with ELMR presence/absence data for these specific estuaries." Not only does that statement, and some others in the documents, confirm that MDMF information was examined by NMFS writers, but you should know that ELMR data in specific 'estuaries' ought to coincide with OUR data since it IS OUR DATA in a qualitative format, albeit a bit dated!

We regard it as a loss of important EFH information for MAFMC managed species when you haven't utilized our trawl survey data when it has always "exist(ed)" in a "format comparable currently to NMFS data", contrary to the statement on p. 82, 4th para, 5th sentence of Summer Flounder/Scup/Black sea bass FMP. Although our program may be the exception, we would appreciate it if the wording would acknowledge our 21 year effort instead of ignoring it.

The best example of the point I am making is all the existing sections designated as 'Description and Identification of EFH' which I regard as deficient. I don't understand why the MAFMC in "attempting to coordinate and obtain the best information available in Amendment 7, requested each state from North Carolina to Maine identify essential (species) habitat under their jurisdiction", yet failed to designate a 'Preferred Alternative', as the NEFMC did for information other than the NMFS surveys. This could have included: inshore survey results (MDMF, CTDEP, and NMFS Hudson-Raritan/ Sandy Hook Bay); areas already identified in writing by state agency experts (cited in all your documents); and information from the fishing industry, etc. For example, in the case of summer flounder, because your egg and larvae EFH is limited by where the MARMAP survey was conducted, you have excluded many essential inshore areas of recognized egg and larval abundance (Fig. 47 a & b). Utilizing the ELMR data base for larvae, juveniles, and adults grabs only two 'estuaries' northeast of Narragansett Bay (Table 14), thus ignoring much EFH both south and north of Cape Cod. Similarly, relying on the NEFSC trawl survey to discern juvenile and adult EFH (Fig. 47 c & d), excludes important grounds, especially inshore. The determination of EFH for all other MAFMC managed species followed the same flawed rationale.

I submit that if you ask states to provide information, which you did, then why not use it much in the manner of the NEFMC, i.e., the 'preferred alternative'? If Massachusetts DMF had been given an opportunity to have input into the MAFMC process earlier, I would have hoped to prevail on you to utilize the MDMF trawl survey database. I know that this now may not be possible for this iteration; nonetheless, I filled out the 'blank gridded figures' thereby offering you updated knowledge for species stages where, in my judgement, the MAFMC is deficient in the various documents (refer to attached 16 figures). In undertaking this task, I was assisted with fish life stages by Tom Currier and Jeremy King, who share with me over 20 years marine sampling experience (species, sex, and maturity staging) in state territorial waters, and by David Whitaker and Mike Hickey, who have had similar experience with shellfish resources.

When necessary, we queried our trawl survey database for this undertaking. We are also familiar with all ichthyoplankton study results conducted within territorial waters which, all in all, confirm our maturity observations. Except for the sedentary mollusks and the egg and larval fish and squid stages, distribution plots are for September, when inshore water temperatures are highest and our autumn survey is conducted. Where appropriate, I have combined the distribution of one or more life stages as follows:

Summer flounder Eggs & Larvae
" " Juveniles (Age 0)
" " Adults
Scup Eggs & Larvae
" Juveniles & Adults
Black Sea Bass Eggs & Larvae
" " " Juveniles (Age 0)
" " " Adults
Atlantic Mackerel Eggs, Larvae, Juveniles, & Adults
Loligo squid Eggs & Larvae
" " Pre-Recruits & Recruits
Illex squid Pre-recruits and Recruits
Butterfish Eggs, Larvae, Juveniles, & Adults
Spiny Dogfish Juveniles & Adults (both sexes)
Surf Clams
Ocean Quahogs

The MAFMC has identified submerged aquatic vegetation (SAV) beds as nursery habitat of larvae and juvenile summer flounder and a "habitat area of particular concern" (HAPC). I think this may be a premature designation and might require more research and thought relative to its implications. The basis of the designation is the Packer and Griesbach summer flounder background document. While I have not seen this report, the quote on p. 67, 2nd para of section, suggests that this is a learned opinion based on a review of the literature. I think this nomination should be based on peer-reviewed scientific research as implied in the NMFS Technical Guidance Document. While I don't doubt the validity of the observational information relative to juvenile summer flounder and eelgrass, what are the observations relative to other SAV? It is likely that this important ecological function (the principal criteria that would apply according to the interim final rule) is fulfilled by other SAV, such as _Codium_, etc. What were the observations on other prey species? The northern limit of the spot's (_Leiostomus xanthurus_) range is southern N.J. yet juvenile fluke are found north to Cape Cod where they forage on species other than spot and from cover other than eelgrass. Has it been demonstrated that eelgrass is particularly vulnerable to specific fishing gears, and if so, which ones in place and time would adversely effect juvenile feeding? Or, are you more concerned by environmental degradation, like vessel activity in grass beds, or stresses from development? Importantly, the MAFMC has not described the implications of the HAPC designation; you should be up front about this with all constituent groups. Massachusetts DMF believes it is important that impact to this habitat be accurately described before more stringent management measures should be considered by the MAFMC.

With one exception, the biological material presented for all the species is very complete and well assembled by the various authors. Based on my knowledge of the literature, they did a very good job. With respect to the Summer Flounder/Scup/ Black sea bass document, I suggest two corrections:

p. 11, 3rd para. I am certain that the subject of this paragraph is black sea bass, however, because the first sentence starts with "The species is . . .", the presumption from the second paragraph is that the subject of the third paragraph is scup. The ambiguity should be cleared up.

p. 34, last para. 3rd sentence. I dispute the comment that YOY scup were "not evident (north of Cape Cod) in the Massachusetts DMF results." It all depends on what the author means by "locally abundant"? In point of fact, YOY scup have been taken by MDMF in Cape Cod Bay in 12 of 20 fall surveys. Stratified mean catch/tow at length information suggests to me that in two surveys (1981 and 1994), YOY scup were relatively abundant for that area (15-22 fish/tow @ 7 cm mode). Incidentally, a smattering of older fish (18-24 cm) were noted in 1986, 1993, and 1997 fall cruises.

For the Surfclams and Ocean Quahog document, the last sentence in the last complete paragraph on p. 28 is incorrect. Contrary to the Davis et al. 1997 reference, surfclams have been commercially harvested for many years within Massachusetts territorial waters north of Cape Cod, which we consider our corner of the Gulf of Maine. In 1997, 41,907 bushels were taken from Provincetown to Hull, a figure representing 46% of the state's surfclam catch.

I think the Cargnelli et al. 1998 document on Loligo squid is somewhat deficient in that much of the recent research on growth, seasonal distribution by sex, distribution and abundance of egg mops, and dynamics of the mating system is not included in the habitat section of the FMP. I believe It should be, especially the work of Dr. Roger Hanlon and his colleagues at the Marine Biological Laboratory, Woods Hole (508-289-7710). Given the results of Dr. Hanlon's published research, I suggest that wherever Loligo egg mops are encountered (as MDMF has documented for state waters), it is EFH. If the MAFMC is to assume an active role in the protection of this critical habitat, then Massachusetts DMF recommends that a section on Loligo Eggs and Larvae become components be inserted in the document for this submission package (section 2.2.2) in order to meet Congressional mandates associated with the SFA.

With respect to the Hoar (pers. commun.) information on

With respect to the Hoar (pers. commun.) information on Surfclams and Ocean Quahogs for Massachusetts territorial waters (p. 35, last para.), it is dated and should be re-written based on more recent surveys and information. As shown on the attached grid figures, ocean quahogs are now found in relative abundance from Gay Head, Martha's Vineyard along the south shore of the island out into the EEZ. They are also found in abundance in two separate areas in the southern and southwestern reaches of Cape Cod Bay below the 60' contour. Ocean quahogs are also present within a deep-water rectangular block extending from off Boston north to N.H off Cape Ann but are not now abundant enough to be commercially viable. Surfclams beds extend from Westport (Horseneck Beach) westward into lower Vineyard Sound, and are found in a narrow strip along the south shore of Cape Cod from Bass Rip to Point Rip. They are also abundant in Muskegut Channel and in territorial waters all around the backside of Nantucket Island. North of Cape Cod, surfclams beds extend from N.H. to Ipswich Bay, and from Hull south along the shore of Cape Cod Bay to Provincetown. The greatest concentrations in the Bay are from Dennis to Provincetown.

I hope my comments have been helpful.

Sincerely,

Arnold B. Howe, AQB III

SUMMER FLOUNDER
EGGS + LARVAE

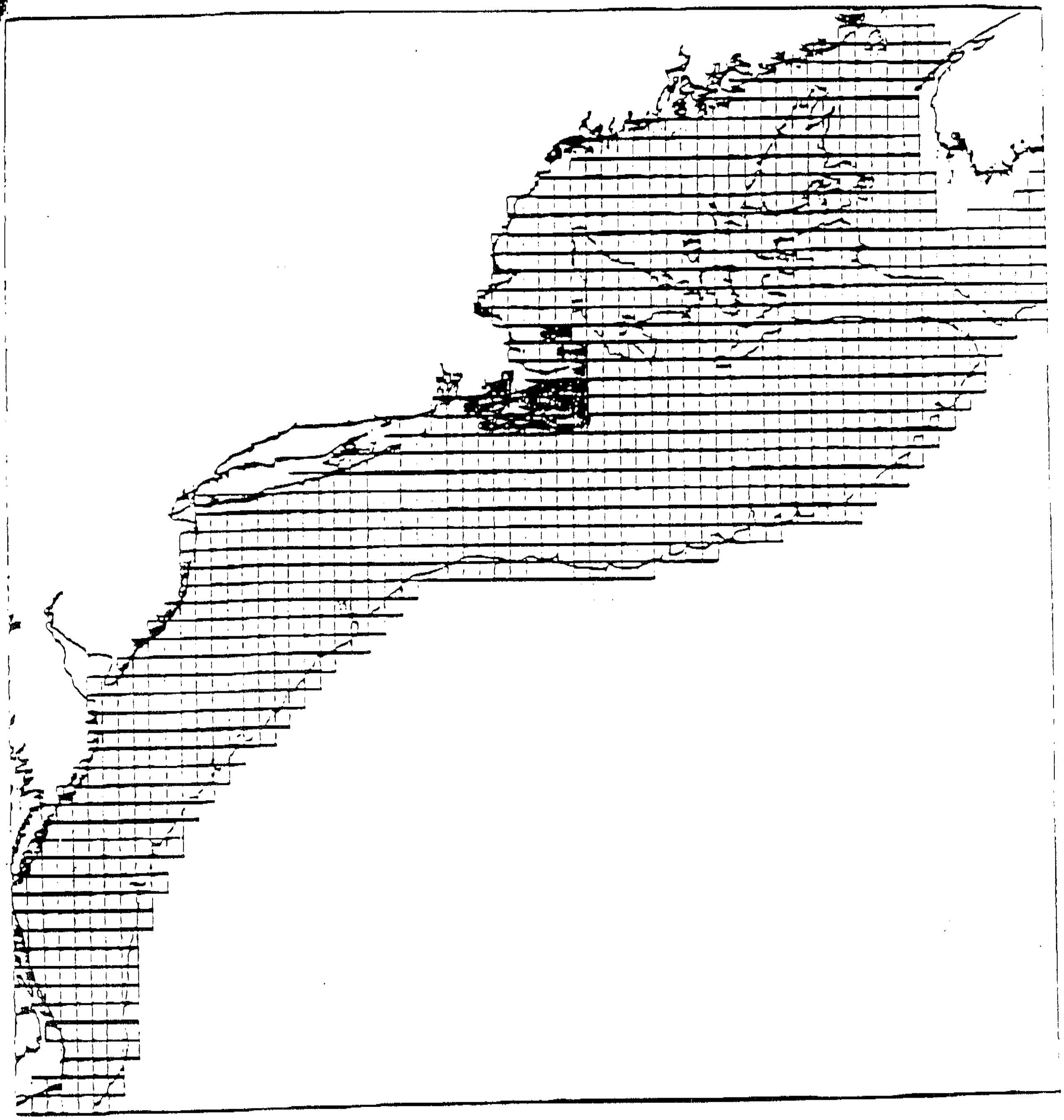

Figure 56. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

SUMMER FLOUNDER
JUVENILES (HEEO)

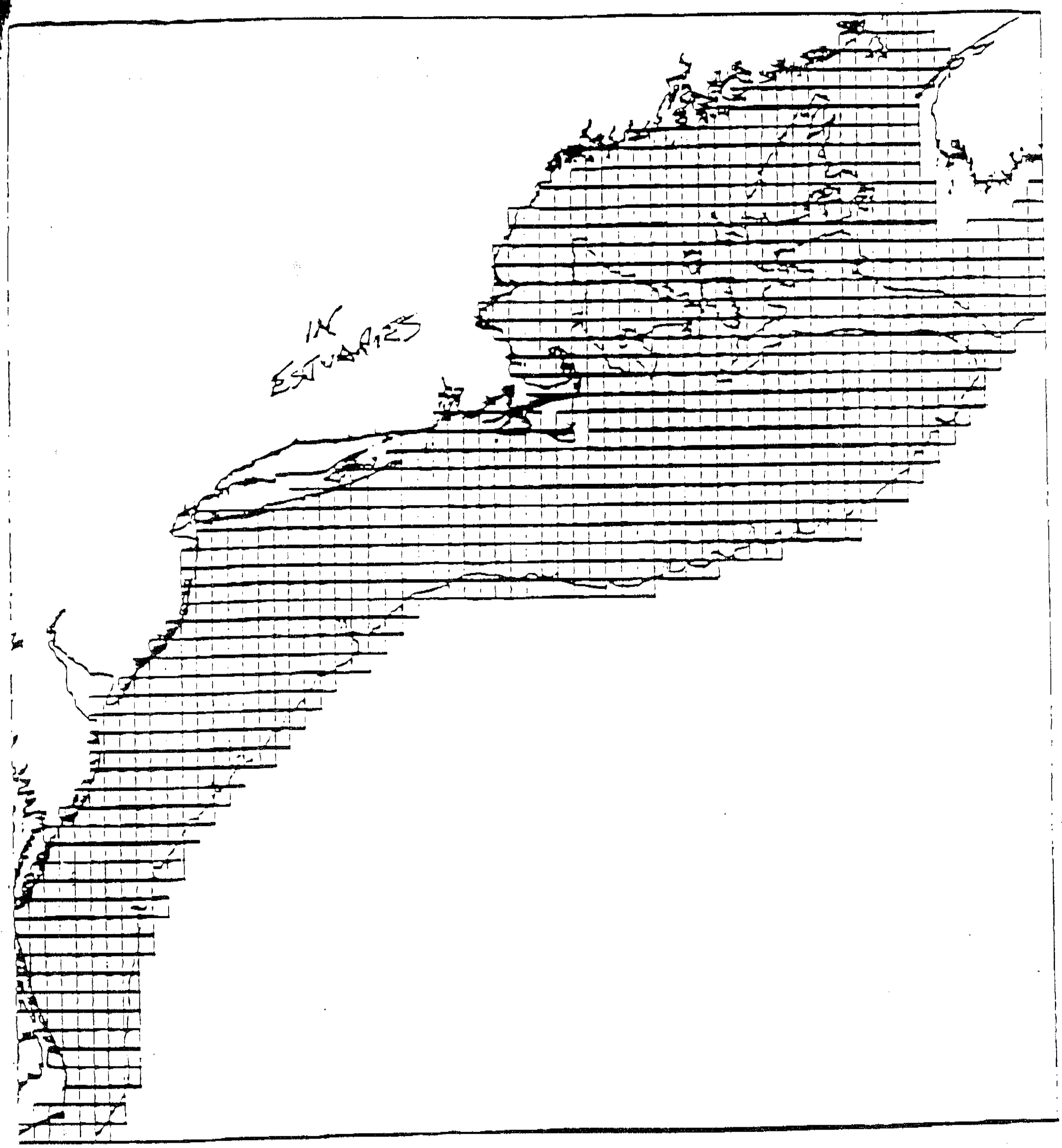

Figure 58. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

SUMMER FLOUNDER

ADULTS

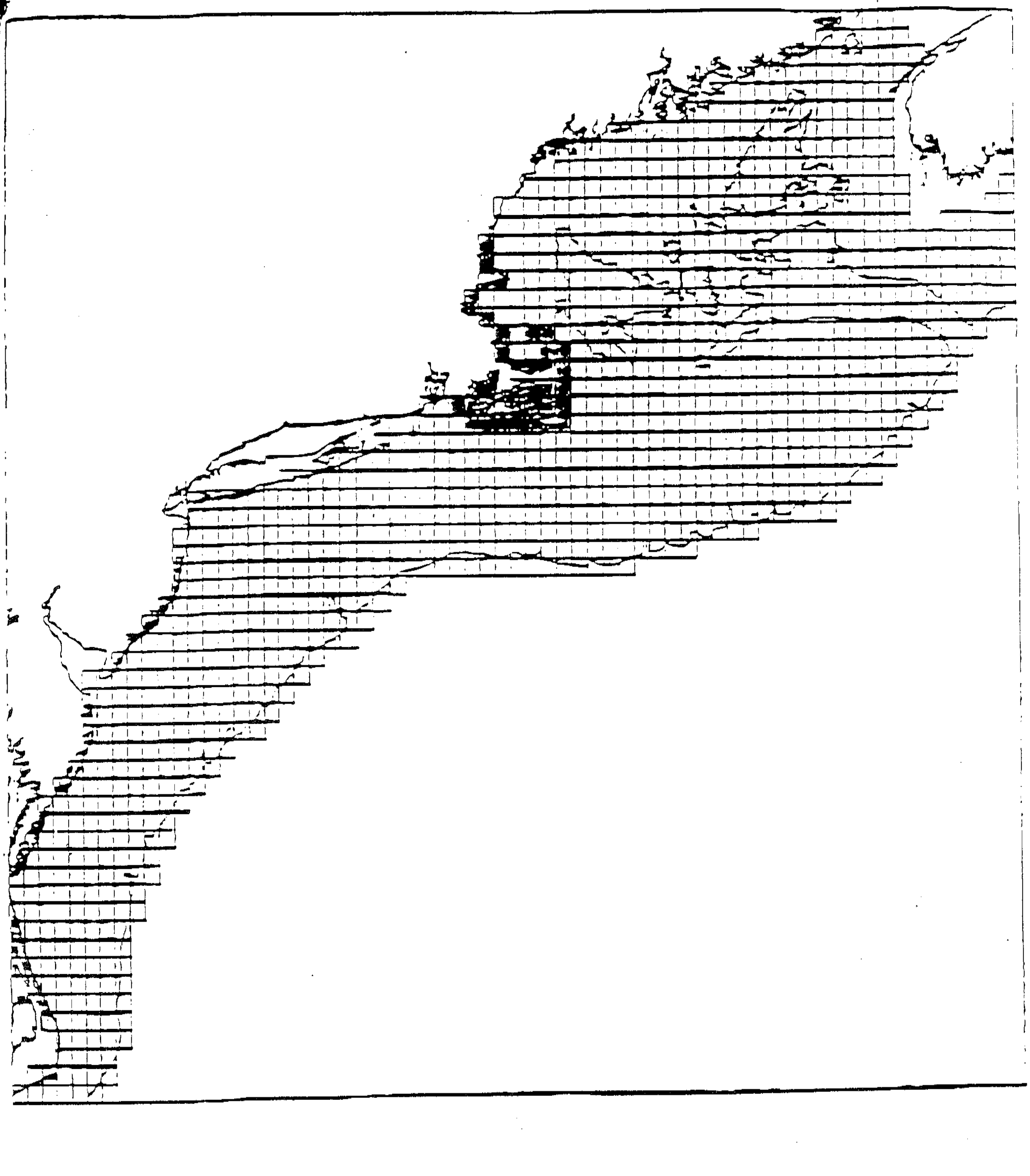

Figure 58. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

SCUP
EGGS + LARVAE

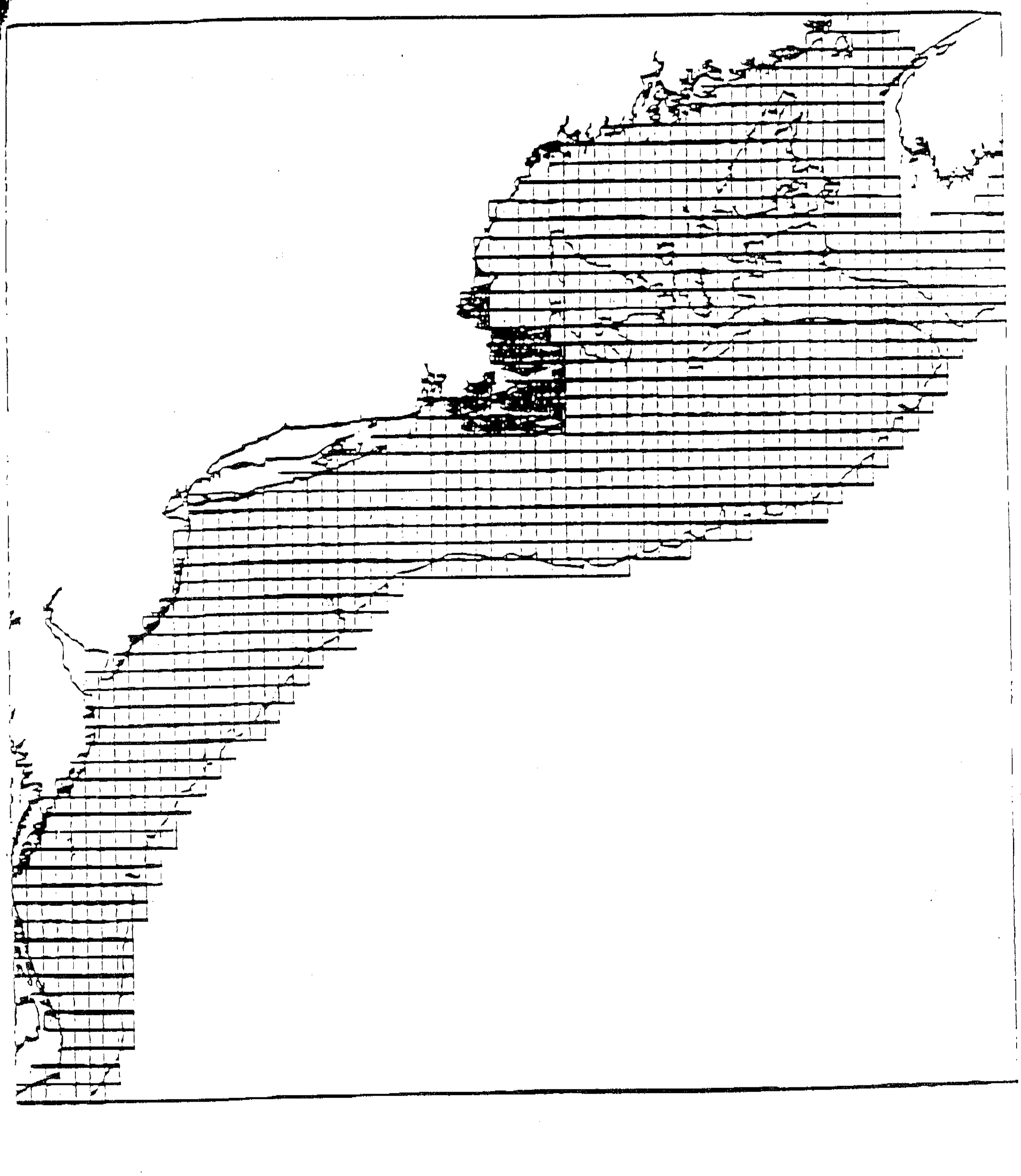

Figure 56. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

SCUP
JUVENILES + ADULTS

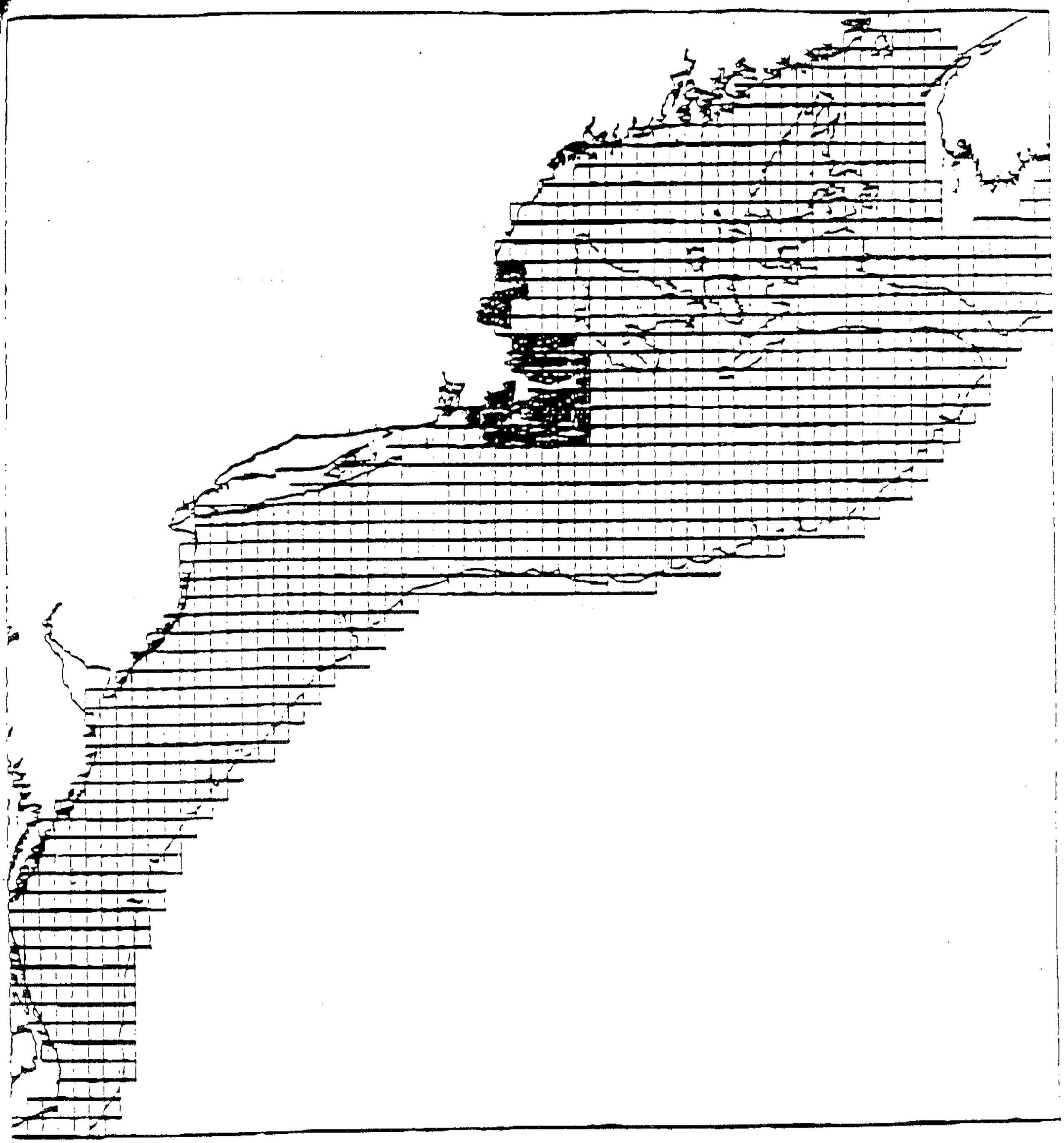

Figure 56. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

BLACK SEA BASS
EGGS + LARVAE

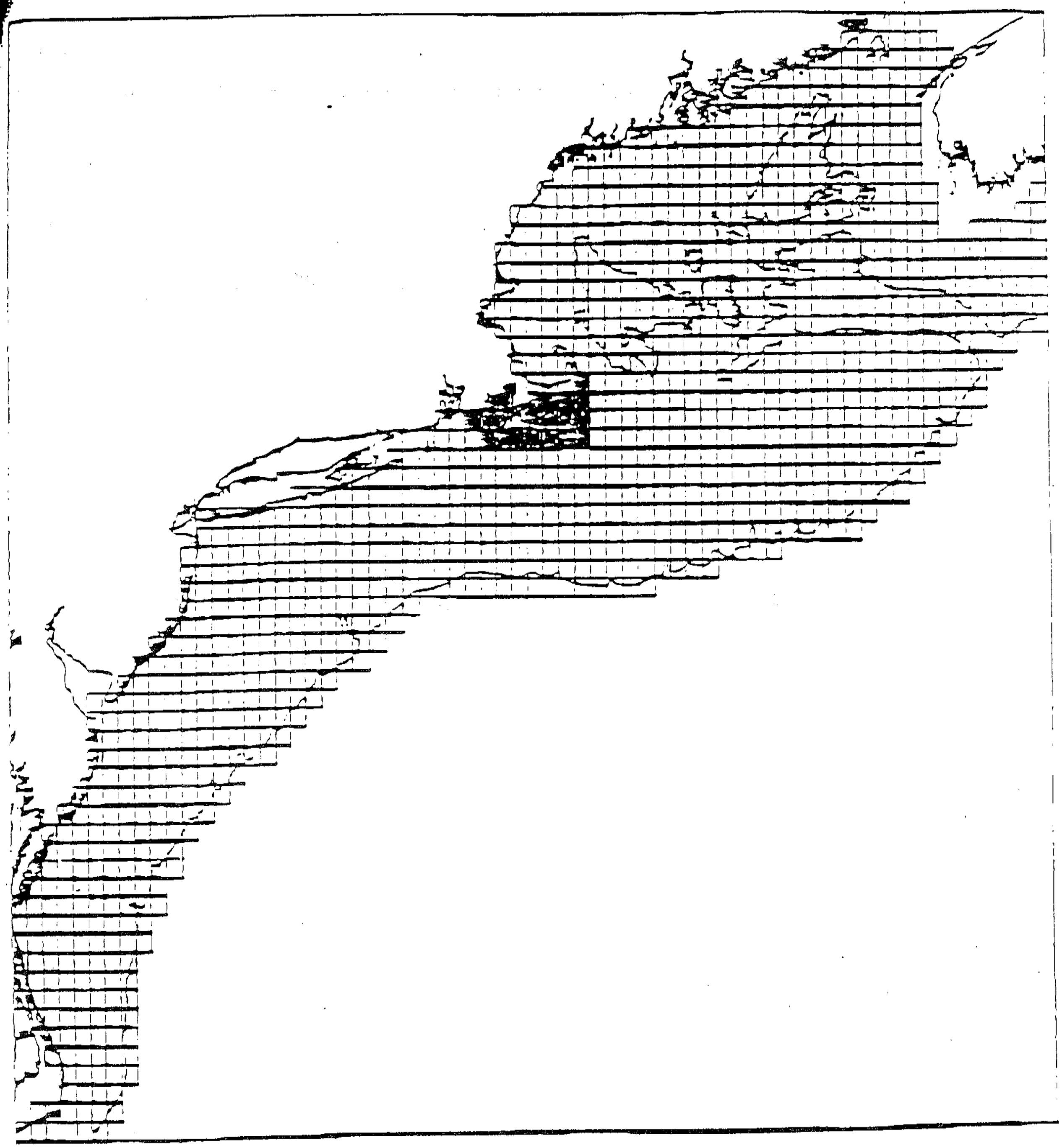

Figure 56. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

BLACK SEA BASS
JUVENILES (YOY)

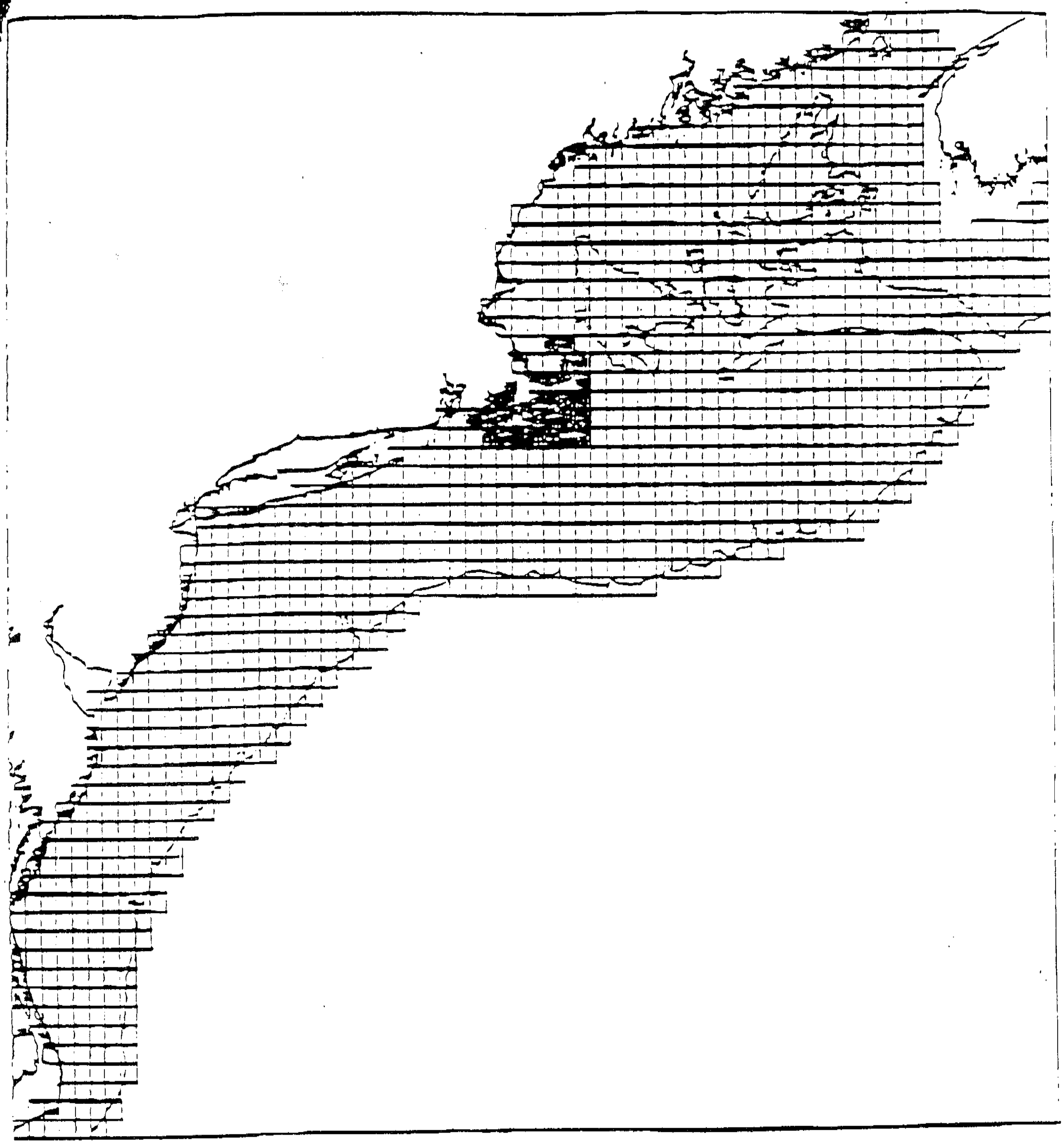

Figure 58. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

BLACK SEA BASS
ADULTS

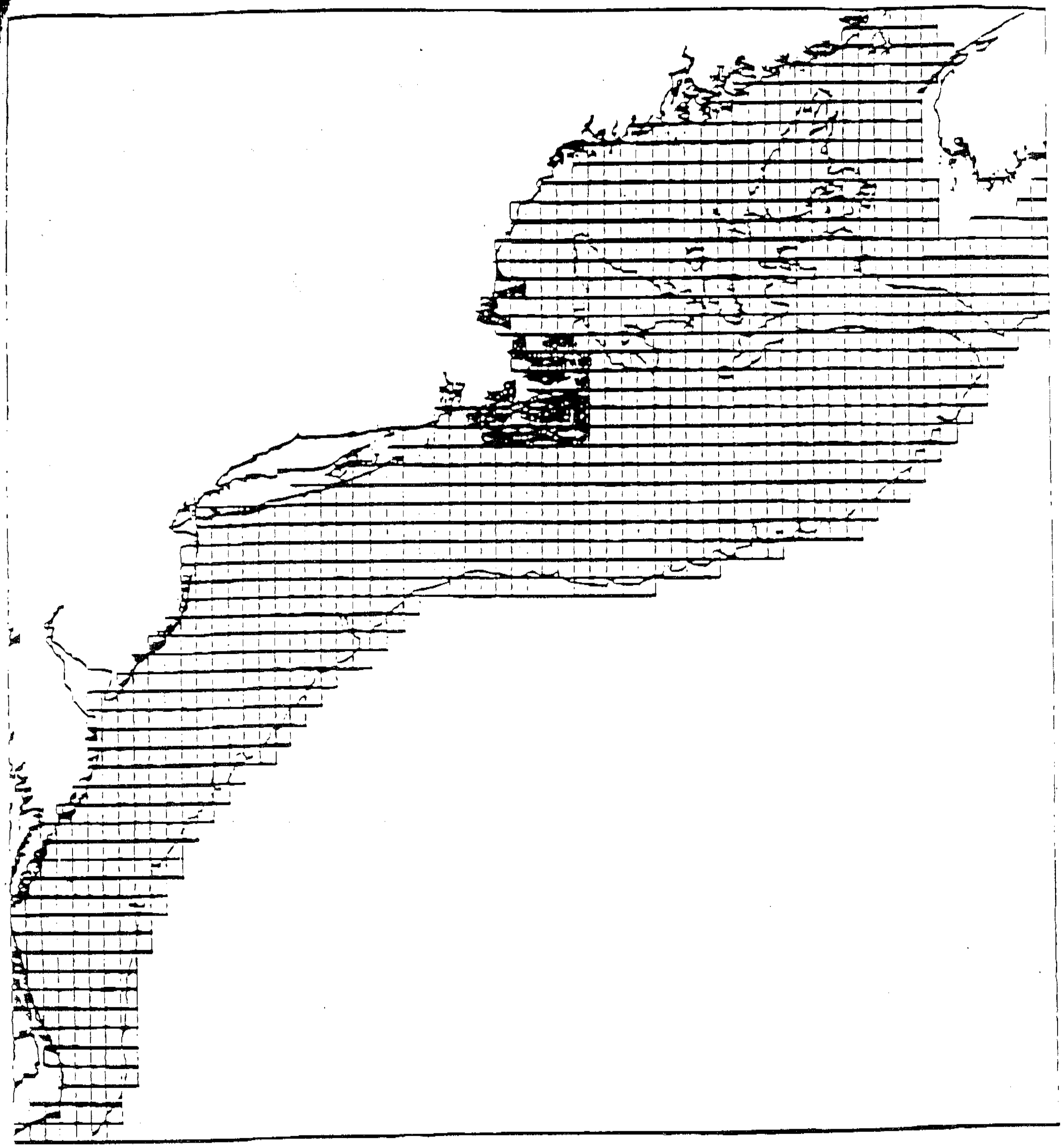

Figure 58. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

AT. MACKERAL
EGGS, LARVAE,
JUVENILES, ADULTS

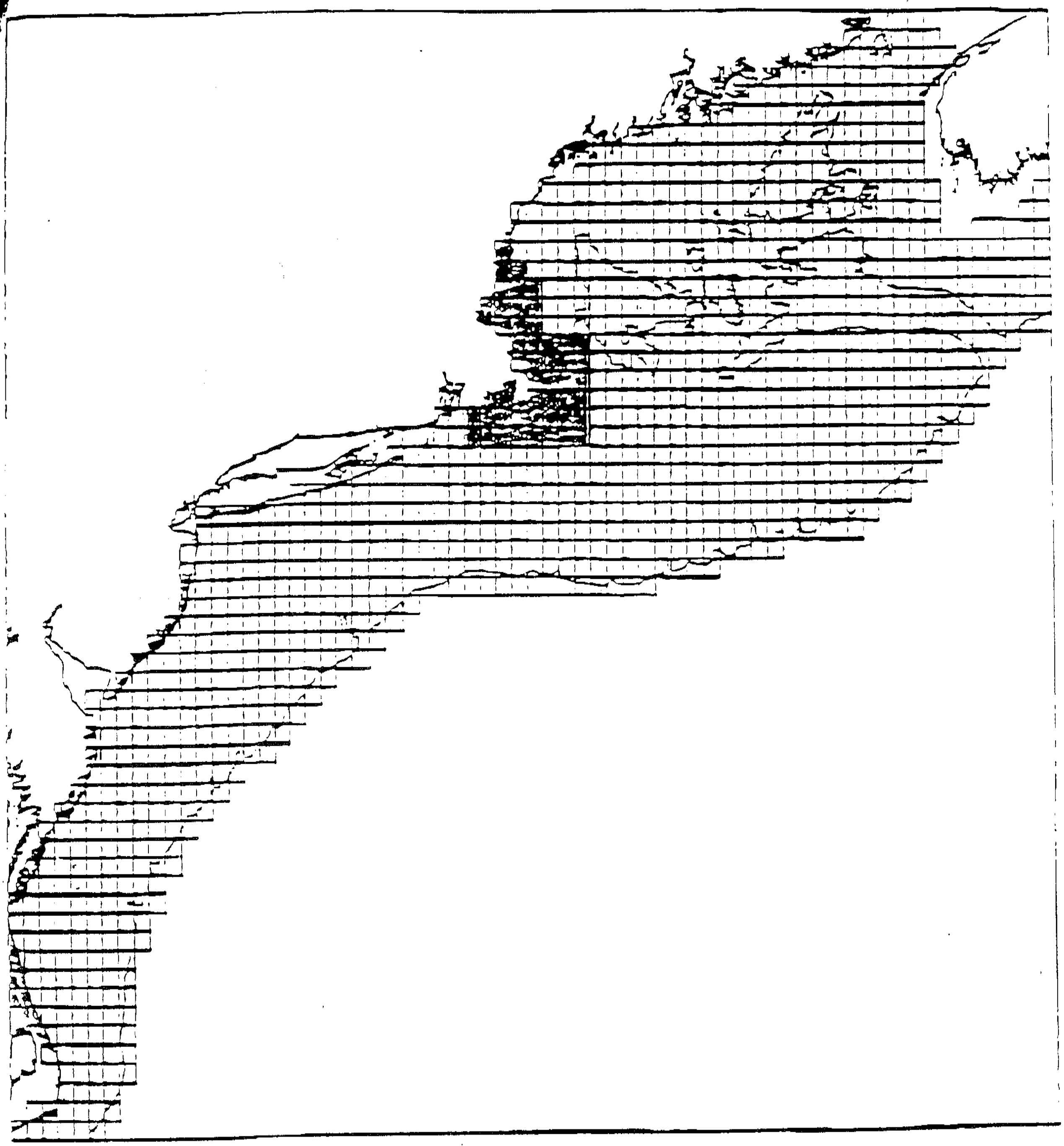

Figure 56. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

LOLIGO
EGGS + LARVAE

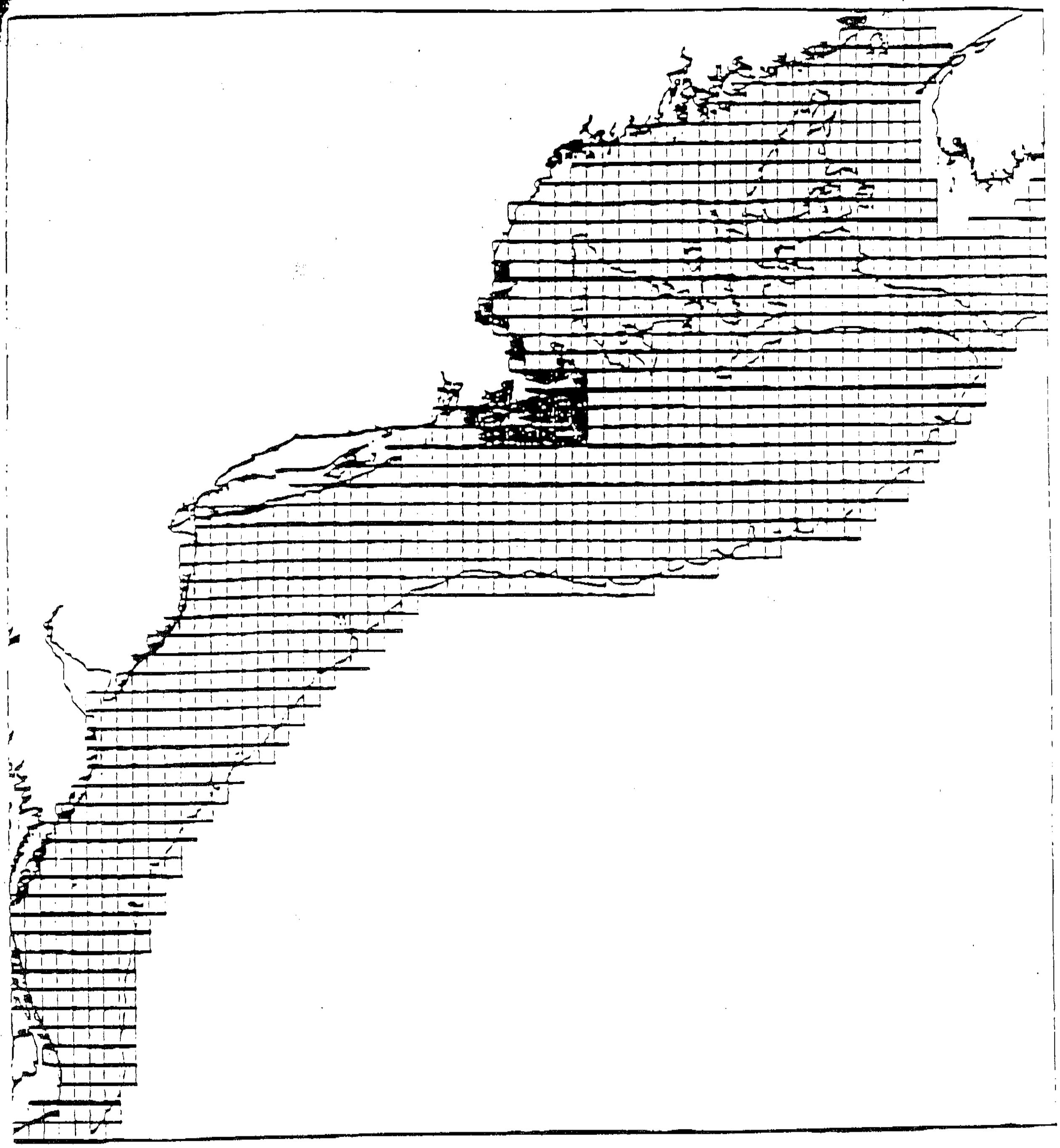

Figure 56. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

LOLIGO
PRE-RECRUITS & RECRUITS

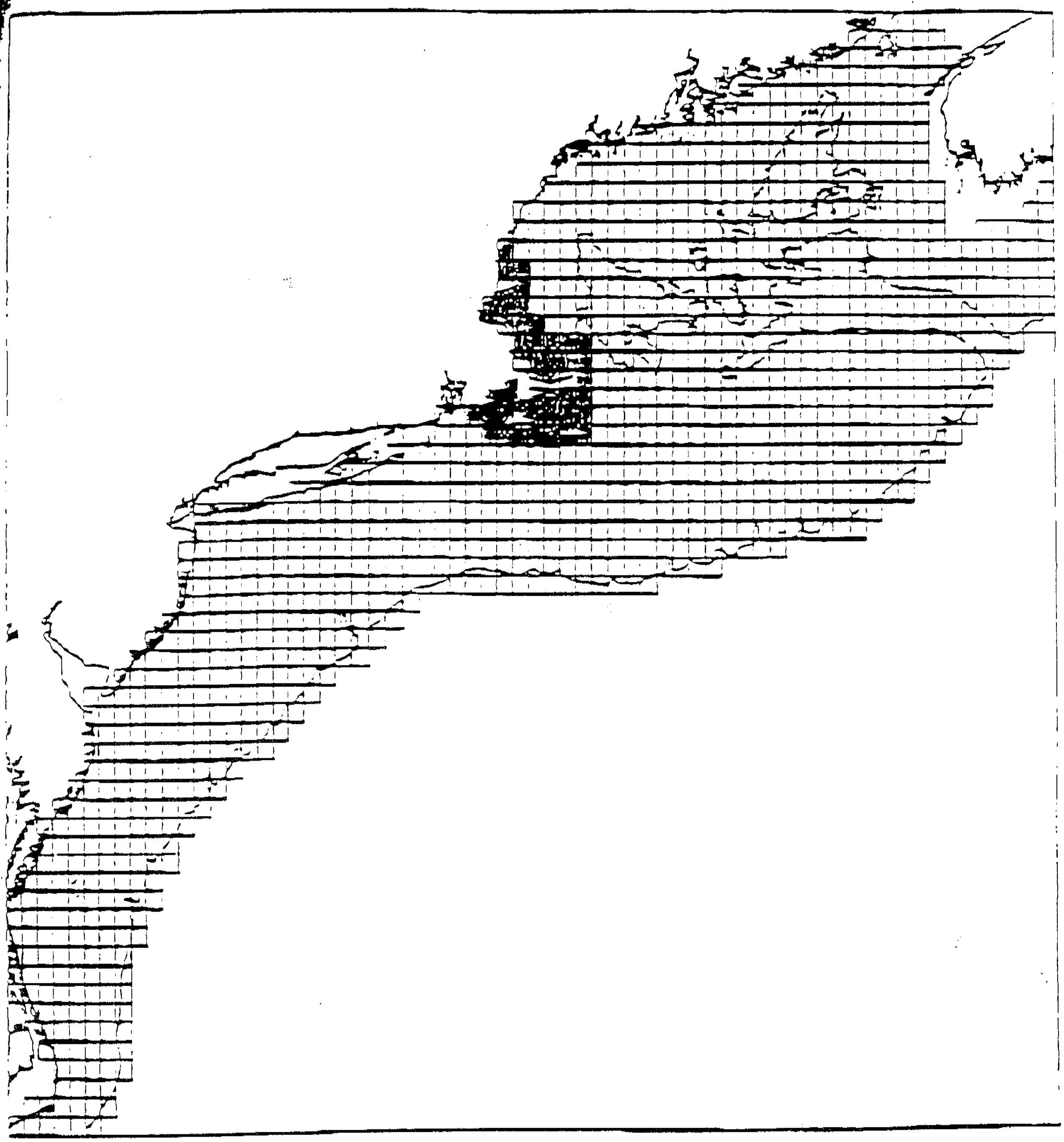

Figure 56. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

ILLEX
PRE-RECRUITS & RECRUITS
(AUTUMN)

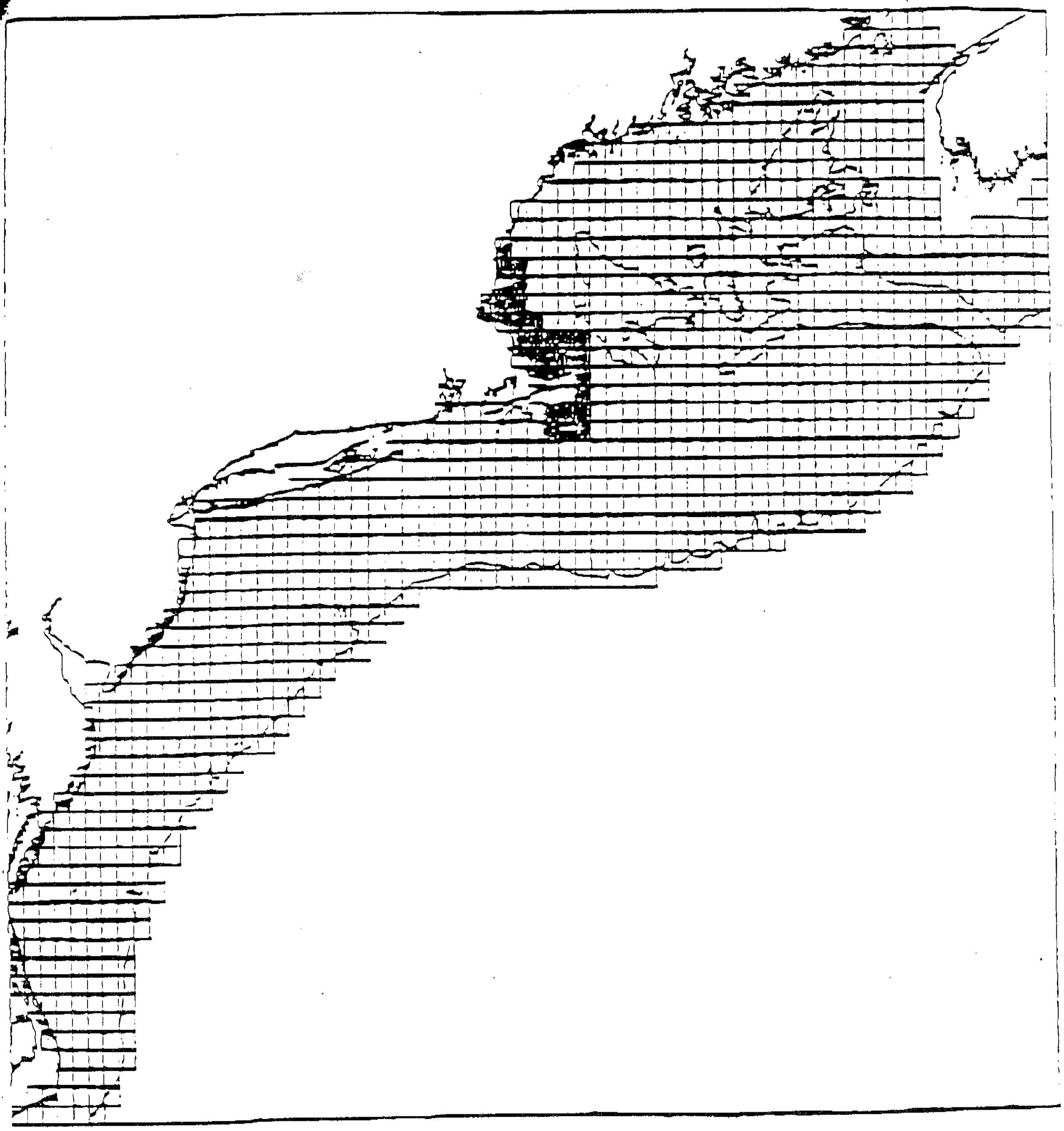

Figure 56. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

BUTTERFISH
EGGS, LARVAE,
JUVENILES, ADULTS

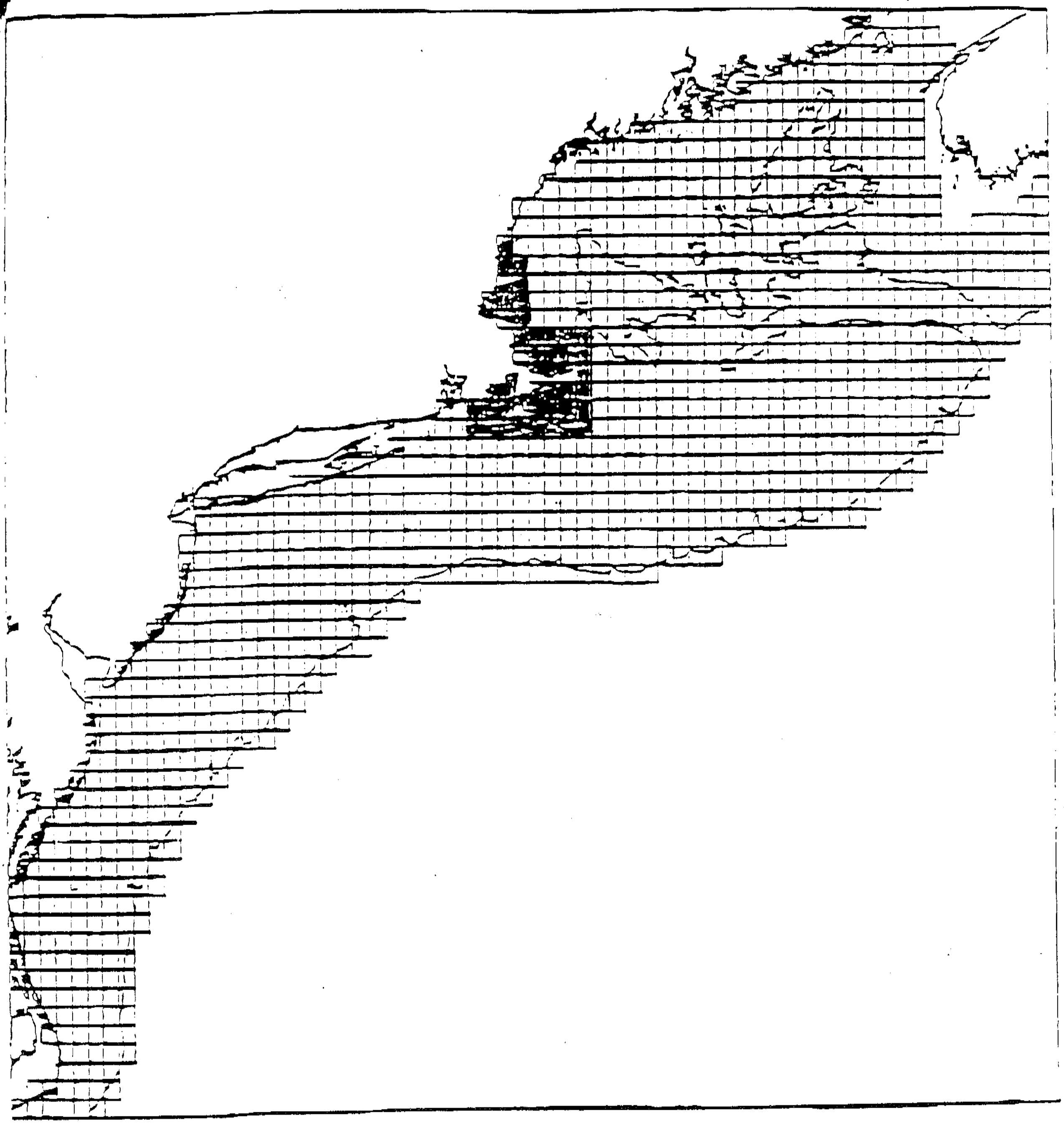

Figure 56. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

SPINY DOGFISH
JUVENILES (both sexes)
ADULTS (" ")

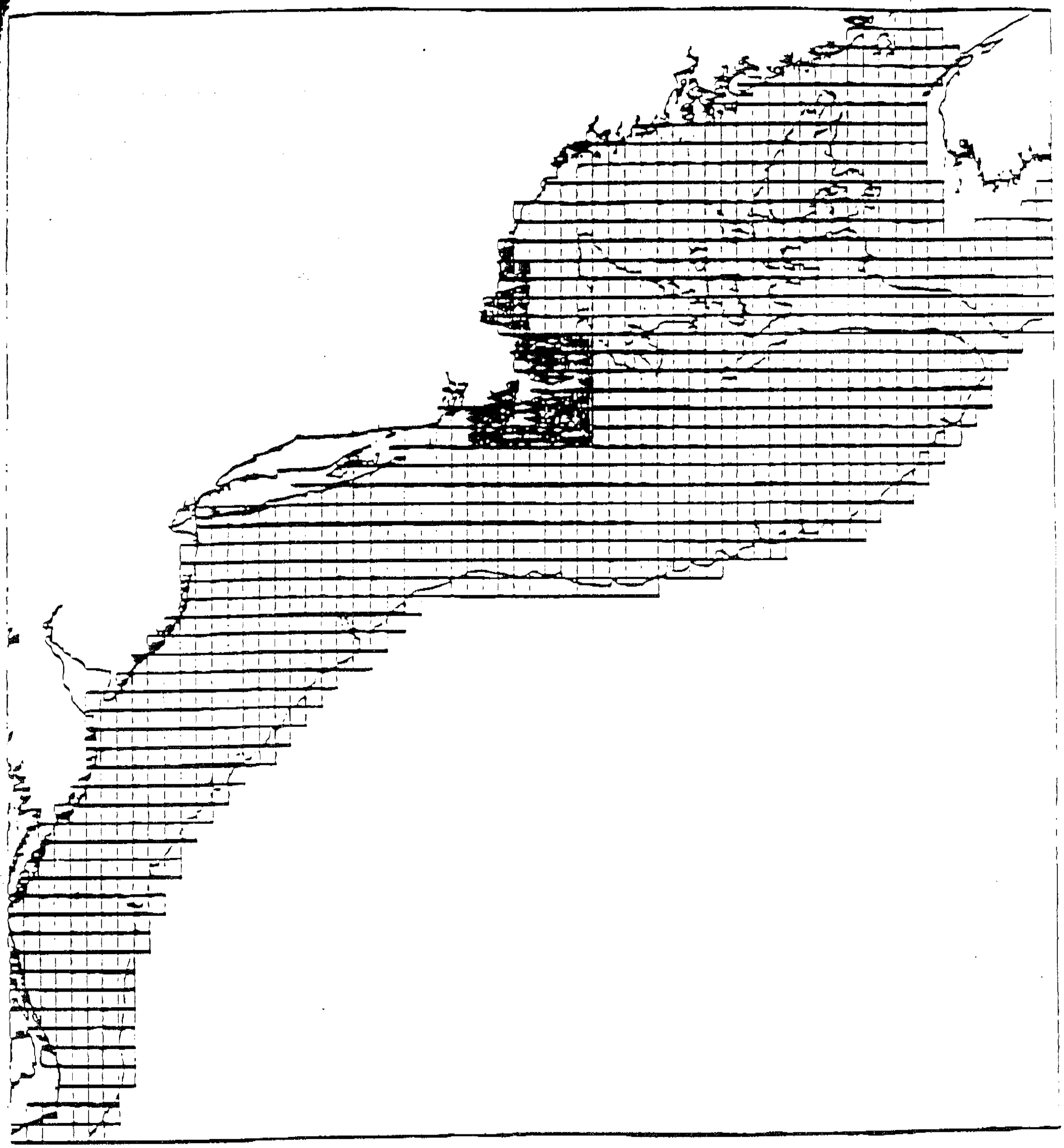

Figure 56. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

SURF CLAM

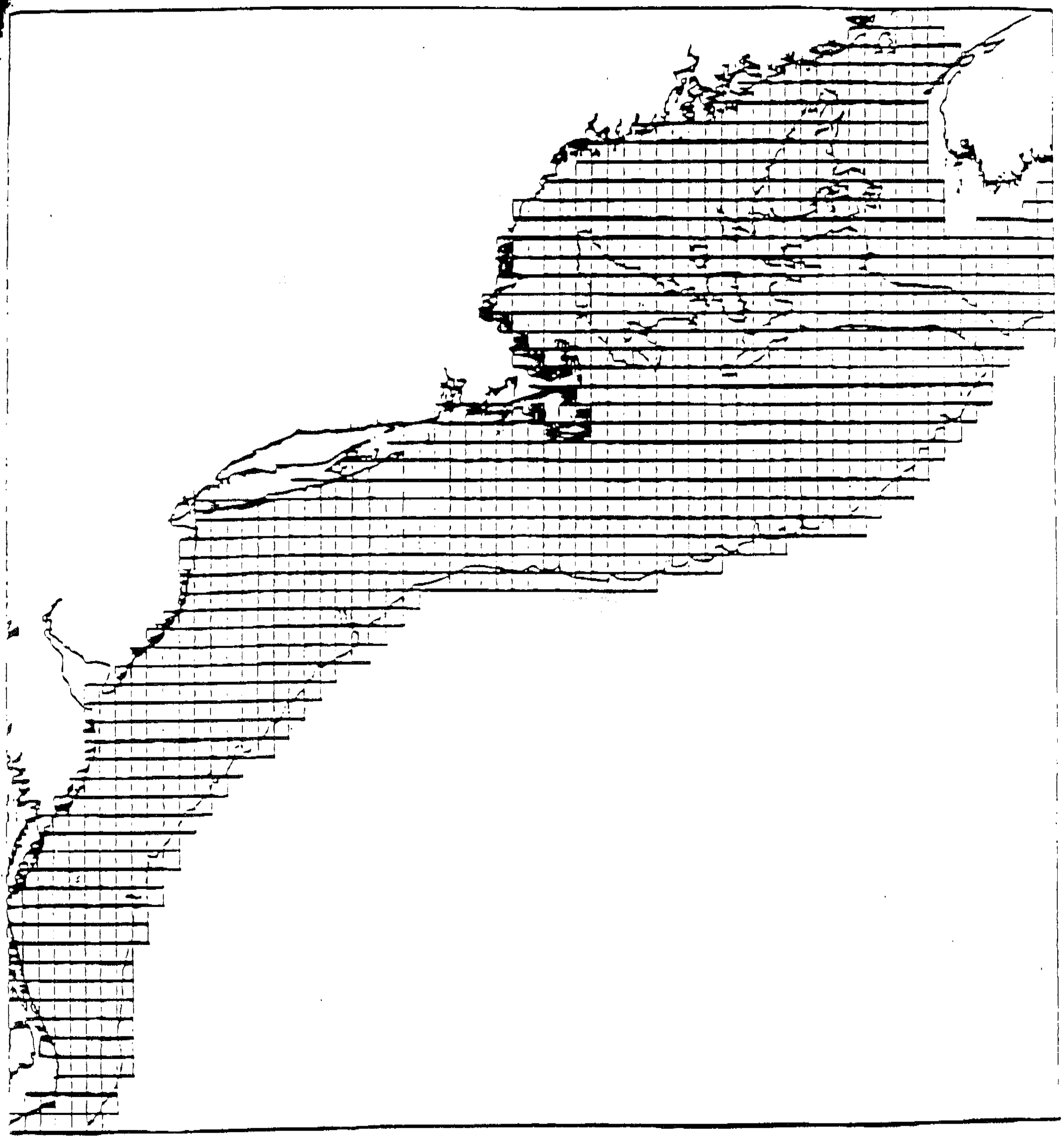

Figure 56. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

CLEAN QUAHOGS

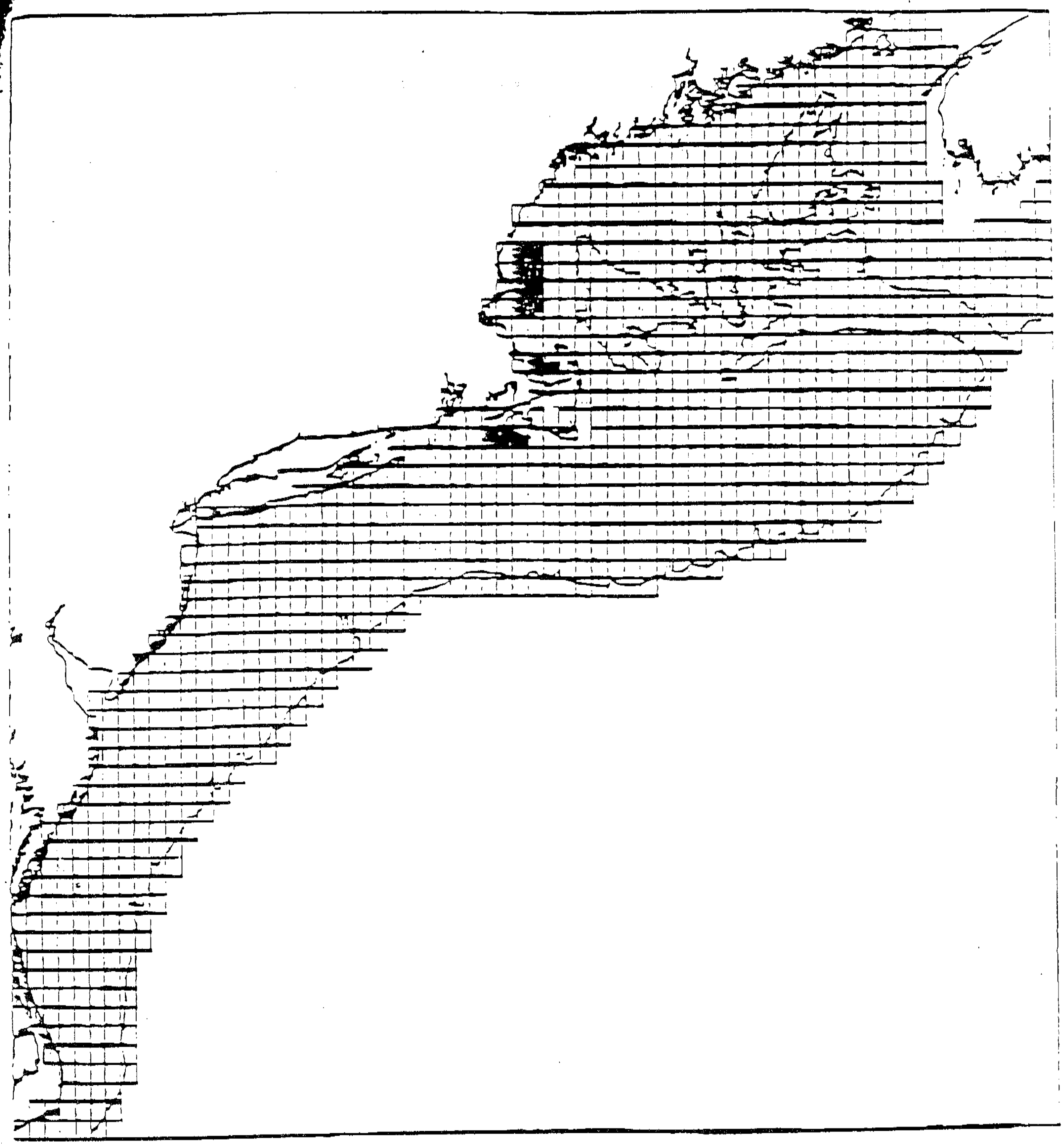

Figure 56. Blank 10 minute grid, north of Cape Hatteras, NC for input by the public on EFH.

AF&PA

AMERICAN FOREST & PAPER ASSOCIATION

FAX

1111 19th Street, NW Suite 800
Washington, D.C. 20036

Legal Department
FAX: 202/463-2052

TO:	**Christopher Moore**	FAX:	302/674-2331 X5399
FROM:	Chip Murray	PHONE:	202/463-2782
DATE:	September 25, 1998	TIME:	3:28pm

NO. PAGES: 6

MESSAGE:

Following are comments on the three FMP amendments due today. Hard copy is in mail.

AF&PA

AMERICAN FOREST & PAPER ASSOCIATION
Legal Department

September 25, 1998

Dr. Christopher M. Moore, Ph.D.
Acting Executive Director
Mid-Atlantic Fishery Management Council
300 S. New Street
Dover, Delaware 19904

Re: Amendment 12 to the Summer Flounder, Scup and Black Sea Bass Fishery Management Plan; Amendment 8 to the Atlantic Mackerel, Squid and Butterfish Fishery Management Plan; and Amendment 12 to the Atlantic Surfclam and Ocean Quahog Fishery Management Plan

Dear Dr. Moore:

The American Forest & Paper Association (AF&PA) hereby submits the following comments on the August 21, 1998 drafts of Amendment 12 to the Summer Flounder, Scup and Black Sea Bass Fishery Management Plan (FMP); Amendment 8 to the Atlantic Mackerel, Squid and Butterfish FMP; and Amendment 12 to the Atlantic Surfclam and Ocean Quahog FMP. AF&PA is the national trade association of the forest, pulp, paperboard, and wood products industry. AF&PA represents approximately 250 member companies and related trade associations (whose memberships are in the thousands) which grow, harvest and process wood and wood fiber; manufacture pulp, paper and paperboard products from both virgin and recovered fiber; and produce solid wood products.

While we support the goal of conserving essential fish habitat (EFH), we object to the scope and reach of these amendments. We strongly believe that the amendments represents a clear departure from the letter of the Magnuson-Stevens Fishery Conservation and Management Act and the intent of Congress in adopting the "essential fish habitat" amendments in the 1996 Sustainable Fisheries Act.

The draft amendment for summer flounder, scup and black sea bass, all of which are described as currently overfished, would designate selected estuaries as EFH, based on 90% of the catch, north of Cape Hatteras. South of the Cape, it would designate the entire coast as EFH for summer flounder. EFH for scup and black sea bass is under the jurisdiction of the South Atlantic Fishery Management Council and they have proposed designation of estuaries south of the Cape.

The draft amendment for Atlantic mackerel, squid and butterfish, which are described as not currently overfished, would designate selected estuaries as EFH, based on 75% of the catch, north of Cape Hatteras. South of the Cape, it proposes no EFH due to lack of data and because the species are not being overfished.

1111 Nineteenth Street, NW, Suite 800 ▪ Washington, DC 20036 ▪ 202 463-2700 Fax: 202 463-2052

The proposed amendment for Atlantic surfclam and ocean quahog would designate limited coastal areas as EFH, based on 90% of the catch, from Cape Hatteras to Cape Cod. The Council chose the 90% factor in part due to lack of data on habitat needs of eggs and larvae.

The following comments expand on our concerns.

1. The Draft Amendment Is Overly Broad and Exceeds Congressional Intent

At the outset, it should be understood that the 1996 amendments (Sustainable Fisheries Act) to the Magnuson Act do not authorize the promulgation of standards or regulations that affect nonfishing entities. By its terms, the EFH provision is limited to "the description and identification of essential fish habitat in fishery management plans." 16 U.S.C. § 1855(b)(1)(A). This limitation makes it clear that NMFS' authority applies only to "fisheries." There is no basis in the Magnuson Act for the Councils to address nonfishing activities. Hence, the Councils' description of EFH and measures to preserve EFH goes beyond the underlying statutory authority and is invalid.

Further, the Sustainable Fisheries Act provides that:

> The term "essential fish habitat" means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.

16 U.S.C. § 1802(10) (emphasis added).

The draft amendments would appear to go far beyond the statutory understanding of EFH. The Council's approach to describing EFH is fundamentally at odds with the apparent approach of the Congress in limiting EFH to that which is "essential" or "necessary." EFH should not include any and all habitat nor should it include habitat per se. This approach, on its face, exceeds the authority granted under the Magnuson Act.

2. Inland Areas and EFH

We note that EFH descriptions identify estuarine areas and rivers where juveniles of managed species may occur. We urge the Council to carefully review and revise the amendment in light of the Congress's EFH definition and its historic approach of limiting and constraining the Council and NMFS authority when dealing with fishing interests, as opposed to inland industries, and in deferring to individual states when it comes to matters taking place in state waters, particularly inland waters. There is no authority under the Magnuson Act for the Councils to address prey species or inland areas as EFH, and the Council should avoid any suggestion that EFH will be designated to include such species or areas. E.g., 16 U.S.C. § 1852(a)(1) (the Councils are limited to the management of fisheries "seaward" of the states comprising each Council); 16 U.S.C. § 1801 (b)(1) (the purpose of the Act is "to take immediate action to conserve and manage the fishery resources found off the coasts of the United States"); 16 U.S.C. § 1856(a)(1) (carefully delineating federal and state jurisdiction). Moreover, the Council should focus its efforts on habitat that is truly "essential" and "necessary."

The Council has included estuarine areas as EFH, as well as rivers and other freshwater areas. Further, the Council appears to broadly expand its description of EFH by focusing attention on upland activities that fall well outside the confines of EFH and should not be identified as affecting EFH. In summary, we believe that this definition or description far exceeds statutory authority and the intent of Congress in adopting the EFH provisions to the Magnuson Act.

The Council states in the draft amendments that the alternatives for describing EFH were initially developed for the Bluefish FMP amendment. While we do encourage consistent approaches to similar issues, it appears that the Council also used the same discussion of nonfishing adverse effects with the same suggested conservation and enhancement measures in all four FMP draft amendments, beginning with the Bluefish FMP. We strenuously object to boilerplate descriptions of forestry and other nonfishing adverse impacts, even in the impact priority subsection at 2.2.5.1. Even though the Surfclam and Ocean Quahog FMP amendment provides a more extensive analysis in the priority section, it then repeats the boilerplate for each nonfishing activity with no effort to show how a particular activity impacts clam EFH. Without any connection to the EFH of the species managed under the FMP, these discussions are at best meaningless or, at worst, will cause severe overreaction and overregulation by Council and NMFS staff, not to mention the public.

3. "Silvicultural NPS" - Subsection 2.2.5.3.3 (2.2.5.4.3 in the Clam FMP)

The apparent purpose of the first two paragraphs is to assert that silviculture has significant potential to affect EFH. These paragraphs (a) overstate the importance of silviculture as a nonpoint source of water quality problems and (b) fail to show any connection between silvicultural activities and EFH for any of the species.

The first paragraph of the subsection begins with a sweeping indictment of "Federal land management" for "contributing to the decline of marine and anadramous fish." Various land management activities are identified along with their potential effects on surface waters and fish habitat. Many of the listed activities (e.g., grazing, mining, hydropower development) have nothing to do with silviculture. It is not clear why a subsection on "Silvicultural NPS" includes a general expression of concern about Federal land management activities. Moreover, it is not clear how this general concern connects silviculture with EFH for these species. Most of the Federal forest lands in the eastern U.S. are in mountainous areas many miles from the Atlantic coast. On lands that are near the coast (e.g., Francis Marion National Forest), silvicultural activities are generally focused on wildlife habitat improvement and ecosystem management objectives.

The second paragraph of the subsection comprises carefully selected statements about silvicultural contributions to nonpoint source pollution. The intended message is that managers of EFH should be very concerned about silviculture. These managers should be presented with a more complete and balanced discussion of silvicultural NPS that has some relevance to the particular EFH. It should be noted, for example, that silviculture is a very minor source of NPS pollution in the eastern U.S. compared to agriculture and urban runoff. All states with significant forestry activities have nonpoint source control programs that address silvicultural NPS. Most silvicultural activities are conducted using Best Management Practices (BMP) that are very effective in controlling silvicultural NPS.

Given that localized effects on sediment and temperature in headwaters are the main water quality concerns associated with silviculture, it seems unlikely that silviculture would have any appreciable effects on the EFH for any of the species in these FMP amendments. If there is any evidence to the contrary, it should be included in the particular amendment.

Many of the conservation measures listed in the draft subsection are already included in state BMP manuals. Inclusion of these measures here is potentially confusing to landowners who may receive slightly different versions from various government sources. It would be better to make reference to state BMP manuals than to repeat the information in the FMPs.

Road Construction and Lack of Thresholds. Throughout the documents, no baselines are established to determine whether the stated impact is significant and worthy of addressing or whether it is trivial. For example: "Delivery of sediment from road construction or reconstruction should be reduced." Reduced from and to what levels?

Vague Statements Relating to Harvest Regimes. The documents are altogether vague in places: "Appropriate skid trail location and drainage and proper harvesting in SMAs should be addressed. No guidance is given in the draft Amendments. Standards pertaining to timber harvest can generally be found in federal and state laws, regulations and guidance documents. Generally these statutes, rules and guidelines set forth objective standards. However, here, instead of objective standards from applicable BMPs, the FMP amendments will likely result in a process in which determinations of "appropriate" and "proper" depend on the particular views, values and objectives of the local agency biologist.

Enforcement of Water Quality Standards. The documents suggest that best forestry management practices should be enforced to ensure water quality standards are attained. Generally, federal agencies may not bring enforcement actions based on the failure of a water body to attain articulated water quality standards. The better approach is simply to determine BMPs and implementation through existing state programs.

Restoration of Upland Habitat. The documents speak to the issue of restoring riparian and upland habitat; however, such a recommendation is outside the purview of EFH authority and the documents are too vague to be useful.

4. Conclusions

In summary, we believe the draft amendments are flawed and need reconsideration due to the following:

- NMFS and the Council are promoting EFH so as to include all habitat rather than "essential habitat" and without appropriate justification.
- NMFS and the Council fail to describe in sufficient detail how the listed nonfishing activities represent a "threat" to EFH and what conservation and enhancement measures NMFS contemplates in addressing these "threats," instead relying on boilerplate descriptions.

- NMFS and the Council should indicated with some precision its intent, if any, to extent EFH consultation to areas comprising freshwater and where it is described as EFH.
- NMFS and the Council should clarify and elaborate on its views as to what activity would trigger the EFH consultation requirement.
- NMFS and the Council should produce a realistic assessment of forestry and recognize existing state BMP programs, rather than introducing vague and confusing measures of their own.

We believe that the amendments before the Council, if adopted, will violate the spirit and intent of Congress in adopting the EFH amendments. The proposed amendments go beyond the overly broad, complex, and burdensome approach to EFH articulated in the NMFS proposed and interim final EFH regulations.

If you have any questions, please do not hesitate to contact me.

Very truly yours,

William R. Murray

William R. Murray
Natural Resources Counsel
202/463-2782

Mr. and Mrs. Edward T. Smith
7605 Worcester HWY.
Newark, MD 21841

9/4/98

Dear Sirs,

Regarding the amendments to the managment plans for Flounder, Scup, Sea bass, Surf Clam, Mackeral, etc:

Regarding habitat damage from fishing gear ,pots and dredges are considered to cause potential damage. Any damage from pots is insignificant compared to dredges that not only scrape the bottom but destroy pots and other gear.

Pots do not ghost fish as stated in the plan. Pots have biodegradable panels if they aren't all wood, inwhich case they are eaten by worms in a few weeks.

Overpopulation is blamed for habitat degradation. Overpopulation in the United States is from immigration; our birthrate is at replacement level or below for nonimmigrants. N.M.F.S. should reccommend that congress curtail immigration.

The paper work reduction act is mentioned. Have you considered the time required to read 3 ammendments of over 200 pages each? Working people don't have time for this.

The framework adjustment process won't allow fishermen time to plan for changes or find other sources of income.

Overfishing definitions are indecipherable. They should be explained so a fisherman or even a member of congress could understand them. It sounds like"We don't know this; so we're going to guess at it", writen in gobbly gook.

Sincerely,

Mr. and Mrs. Edward T. Smith

RECEIVED
SEP - 8 1998
MID ATLANTIC FISHERY COUNCIL

Valerie E., Inc.

102 Teal Road
Rio Grande, N.J. 08242
(609) 886-1086

September 25, 1998

via facsimile

Christopher M. Moore, Ph.D.
Acting Executive Director
Mid-Atlantic Fishery Management Council
Federal Building, Rm. 2115
300 S. New St.
Dover, DE 19904

Dear Dr. Moore:

We recommend that the proposed surfclam overfishing definition in the 21 August 1998 Hearing Draft of ***Amendment 12 To The Atlantic Surfclam and Ocean Quahog Fishery Management Plan*** be modified to include the biomass estimates for the **entire** federal resource. We strongly disagree that the 1997 biomass estimate for Northern New Jersey (NNJ) is a reasonable proxy for B_{MSY} for the following reasons.

1. The Atlantic surfclam is found in both state waters and the U.S. EEZ along the Atlantic seaboard from Maine through North Carolina, however, the proposed surfclam overfishing definition only considers 36% of the coast-wide resource.

2. The NNJ surfclam biomass does not accurately represent the entire federal resource. There are vast regional differences, such as landings per unit of effort (LPUE), production rates, and exploitation rates, which will not be considered under the proposed definition.

3. The proposed definition does not protect areas outside of NNJ from overfishing. Theoretically, the fishery could harvest every clam outside of NNJ without violating any overfishing regulations. This clearly is against the intent of the Sustainable Fisheries Act (SFA) and does not meet the requirements outlined in National Standard 1.

Thank you for your consideration of these written comments regarding the draft of ***Amendment 12 To The Atlantic Surfclam and Ocean Quahog Fishery Management Plan***.

Sincerely,

Franklin J. Marriner

Franklin J. Marriner

Doreen L. Morehouse

Doreen L. Morehouse

Valerie E., Inc.

F/V Timberline I

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September 16, 1998

VIA TELECOPIER

Mr. Thomas Hoff
Mid-Atlantic Fishery Management
Council
Room 2115, Federal Building
300 South New Street
Dover, DE 19904

Re: Amendment 12 Proposed Surf Clam/Quahog Overfishing Definitions

Dear Tom:

This is to confirm the substance of our telephone conversation yesterday concerning the proposed overfishing definitions for both the ocean quahog and surf clam species.

Based upon my reading of the Amendment 12 draft I believe that implementation of the proposed surf clam overfishing definition, as written, could result in the following scenarios:

1. The geographic area characterized as "northern New Jersey" in the draft becomes "overfished" based upon the proposed new definition. At that point, as a matter of law, not only northern New Jersey but the remainder of the entire EEZ, from Georges Bank through Delmarva, would be deemed to be "overfished" as well. The entire federal resource then would be subject to a moratorium and/or other stock rebuilding programs.

2. The surf clam industry harvests every remaining clam in every geographic area within the EEZ, except for those clams reposing in "northern New Jersey." So long as northern New Jersey is not deemed "overfished" pursuant to the proposed definition, it would be entirely permissible to harvest every other existing clam, in every other region from Georges Bank to Delmarva, without triggering any "overfishing" regulations or constraints.

I understand that you do not disagree that the two foregoing scenarios indeed could play out under the proposed new definitions. Rather, I understand it is your position that, if one or the other of those scenarios should occur, of if other unknown "problems" should arise, we simply can "amend" the overfishing definition at that time. In all candor, this does not sound like a very persuasive defense of the proposed definition. Further, I doubt that the total failure of the proposed definition to protect overfishing in areas apart from northern New Jersey comports with the requirements of the SFA.

From our discussions, I understand that you and Steve Murawski perceive the proposed surf clam overfishing definition as a means of addressing the last SARC's precautionary suggestion that the Council should carefully consider whether quota increases in fact would bring more concentrated effort to bear on northern New Jersey. If this is indeed a legitimate concern (and I do not concede that it is), the Council should address that concern by way of management measures directed at fishing effort which is occurring in the northern New Jersey area.

The attempt to achieve what is really a management objective through the adoption of a new "overfishing" definition constitutes, in my view, a rather alarming misapplication of the legal authority, imparted by Congress, which permits (indeed requires) the adoption of new overfishing definitions for the various federal fisheries. That legal authority was intended to permit the applicable agencies to address overfishing throughout the range of the species, based upon biologically defensible criteria; the intent of the overfishing requirement was not to provide a predicate for implementing policy objectives -- such as area management -- which the SARC might deem desirable but which the Council has never sanctioned.

On a somewhat brighter note, I do realize that the proposed surf clam overfishing definition, if adopted, would render meaningless and unnecessary any future NEFSC surveys of biomass in areas other than northern New Jersey. Since the status of those stocks would thereafter be irrelevant to a determination of "overfishing," we could save a lot of money on future at sea surveys.

Regardless of that possible benefit, please consider whether it would not be preferable to attempt to address the SARC's concerns about fishing in northern New Jersey through new management policies, rather than through the exercise of authority to enact overfishing definitions.

I am providing a copy of these comments to Christopher M. Moore as well, with the request that they be considered responsive to the opportunity for public comment in writing prior to September 25, 1998.

Thank you for your consideration.

Yours truly,

Thomas T. Alspach

TTA/tsd
cc: Dr. James H. Gilford
Surf Clam Committee
NFI Clam Committee

WALLACE &
ASSOCIATES

September 22,1998

Christopher M. Moore, Ph.D., Acting Executive Director
Mid-Atlantic Fishery Management Council
Room 2115, Frear Federal Building
300 South New Street
Dover, DE 19904-6790

Dear Chris:

We would like to comment on Amendment 12 to the Atlantic Surfclam and Ocean Quahog Fishery Management Plan on behalf of our client the North Atlantic Clam Association. The members of the Association understand that the main reason for this Amendment is to comply with the Sustainable Fishery Act (the re-authorization of the Magnuson/Stevens Act).

Over Fishing Definition

Surfclams

Amendment 12 to the surfclam and Ocean Quahog Management Plan proposes to use Northern New Jersey as the proxy for B_{msy} in the surfclam fishery to comply with the overfishing definition under the Sustainable Fishery Act. It is understood that the Northeast Fisheries Center believes that Northern New Jersey has enough net production to support the fishery's current quota. The problem with the concept is that it is a short term solution that cannot deal with reality in the future. As we all know, there are large quantities of clams in the Delmarva area that are not being utilized. It is also understood that the Delmarva surfclam population has negative production. To not include the Delmarva population in the equation in the long term would give a misleading view of the surfclam stock. Therefore, this proposed proxy should only be used in the short term. Today, we do not have the solution to the problem. It is our opinion that after the next survey, the Council should request that the SAW and SARC, while reviewing the surfclam data, should develop a formula that will address the overfishing definition more clearly than the proposed Northern New Jersey proxy.

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e-mail: DHWALLACE@AOL.COM

Ocean Quahogs

We support the concept of the SARC on how to address the overfishing definition for ocean quahogs under the Sustainable Fisheries Act. However, it appears that the Act was never intended to deal with a long lived animal like the ocean quahog. Nonetheless, if the Northeast Center scientist's are happy with it, so are we.

Habitat

In the habitat section on ocean dumping, section 2.2.5.10, we would like to offer the following: it is currently permitted by law to dump fisheries waste at sea in the Federal zone. We understand that Amendment 12 does not try to place additional restrictions on the industry. It does, however, leave the door open for the council to attempt to place restrictions on the fishing industry in the future. We in the fishing community understand that we must insure that the ocean is a safe place for all sea life to flourish. However, we are not putting anything into the system that was not taken from it. And, we do understand that a large amount of organic material in a small area could cause a problem. But we also understand that the fishing industry must do no harm to the ocean because we depend on it for our very survival. Ocean dumping of fish waste has not been a problem in the past, and we do not believe it will be in the future.

Under the current Surfclam and Ocean Quahog Fishery Management Plan which uses ITQs as the management tool, damage to habitat by clam fishing gear is not great, and the digging action is known to release nutrients in the water column which benefits the whole ecosystem. It should be pointed out that the clam fishery no longer must race to catch the clams. Because the fishermen are not out to catch as many clams as possible in a short period of time, they are catching clams much more efficiently and cleanly than before the ITQ system. Today, the clam industry employs good crews and vessels with enough time to catch the number of bushels that they are sent to catch. Therefore, they take their time to do the job right and there is minimal damage to the habitat.

Clam fishing gear covers only a small fraction of one percent of the bottom per year. Surfclams are generally found in the same area year class after year class, therefore, clam vessels return to the same area every five to ten years. Testimony of many scientists has been that in near shore areas large waves do more moving of the bottom in one storm than the clam fishing gear does in years. Storms are more of a factor than clam vessels.

Frameworking

It would be counterproductive to include framework management in the Surf Clam/Ocean Quahog Fishery Management Plan.

The Surfclam and Ocean Quahog Fishery Management Plan is a ITQ system. The clam ITQ plan was designed to get the Council and NMFS out of the every day management of the fishery and give it the maximum flexibility to manage its own affairs. Frameworking is designed to be able to change the management strategy in a fishery when it is understood that the current system does not work. This is not the case with the clam fishery. The ITQ system is working well, and the only responsibility of the Council is to set quotas, size limits, close areas with large numbers of small clams, and open them when the clams grow to legal size. Since the ITQ system has been in effect, the clam industry has only proposed two changes to the plan, operator permits and VTS. Operator permits are part of this Amendment, and VTS would have been but for some bureaucratic rule that would not have allowed enough time for it to be considered. Our point is, this is Amendment 12 to the SCOQ FMP; Amendment 8 put into effect the ITQ system. The four Amendments to this plan since the ITQ system went into effect have not had anything to do with managing the fishery. They have been technical amendments required by Congress and the Maine clam fishery that never should have been implemented. It was a political problem not a management function. Therefore, changing our management plan by making it "frameworkable" is not desirable or necessary. ITQs and fixed quotas provide all of the flexibility necessary for the clam industry.

Operator Permits

As you are well aware, the whole industry asked for operator permits years ago. We feel it is time to bring vessel operators into the enforcement equation, along with vessel owners, who often are not aboard vessels when fishing operations actually take place. We are pleased to point out that enforcement of the clam regulations for the federally permitted vessels has not been a problem since the ITQ system went into effect.

Thank you for your consideration on these issues.

Sincerely

D. H. Wallace

David H. Wallace

Haskin Shellfish Research Laboratory

Reply to: *Eric N. Powell*
6959 Miller Ave.
Port Norris, NJ 08349
[609] 785-0074 ext. 109 (Fax) 785-1544
eric@hsrl.rutgers.edu

September 22, 1998

Jim Gilford
Executive Director
MAFMC
Rm 2115 - Federal Bldg.
Dover, DE 19904

Dear Mr. Gilford:

Roger Mann and I met on Friday, September 18 to go over the contents of Amendment 12. We have serious concerns about the specific language used for the overfishing definitions, that we address in this letter. I have also sent our comments to Paul Rago and Jim Weinberg. Roger and I talked with Paul on Friday to bring him up-to-date and believe we have general agreement on most issues, but he has not yet had a chance to review our comments in detail. Jim is out of town and has not had any contact yet with these proceedings. Our comments follow.

Ocean quahogs

We direct our recommendations specifically to the two paragraphs on p. 4 of the amendment addressing overfishing definitions in ocean quahogs. Should these recommendations be accepted, it would be necessary to modify other portions of the text of the amendment to bring them into agreement.

1. We agree that MSY occurs at about one-half of the virgin biomass: therefore, $B_{msy} = \frac{B_{virgin}}{2}$.
2. The amendment stipulates that the 1997 surveyed biomass is about 80% of the virgin biomass. This is true only of the surveyed (known) biomass (B_{virgin_k})†.

† In general, we strongly urge the MAFMC to delete from Amendment 12 all values for B and F and retain only the parameter definitions. We believe it likely that these

We know that the true virgin biomass (B_{virgin}) is greater than the known virgin biomass: $B_{virgin} > B_{virgin_k}$.

3. National Standard 1 stipulates that the management of fisheries resources should set obtaining OY as a goal. Logically, when a resource has a biomass much above B_{msy}, fishing should be permitted, even though F exceeds F_{msy}, to reduce the biomass to near B_{msy}. Only in this way can MSY be achieved. Applegate et al. (1998), in the report of the Overfishing Definition Review Panel, specifically support this scenario in Figure 2 (lower panel), p. 36 and in section 9, item 3, p. 32. Although specific guidance is not available from Applegate et al. (1998), interpretation of Figure 2 (lower panel) suggests that overfishing targets (F_{target}) can be exceeded as long as the biomass exceeds about 60% of B_{virgin}. This seems to us to be an appropriately conservative approach. In ocean quahogs, $B_{1997} \gg B_{60\%virgin}$, and so we question the need to stipulate F_{target} and $F_{threshold}$ at this time‡.

4. We further question the usefulness of stipulating F_{target} and $F_{threshold}$ at this time because of the number of years that will pass before the surveyed biomass (B_t) drops to $B_{60\%virgin}$. According to information provided in the Stock Assessment Review Committee Consensus Summary of Assessments for the 27^{th} SAW, at a fishing intensity of 22,000 MT (about 5,000,000 bushels*), about 24 yr would be necessary to reduce B_{1997} to B_{msy} and 15 years to reduce B_{1997} to $B_{60\%virgin}$, even in the absence of recruitment∓. Since we can expect considerable advances in our understanding of the population dynamics of the ocean quahog over this much time, it will certainly be necessary to update

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values will be updated in the future as new research from NMFS and other scientists becomes available. Inclusion of a value may result in the need to amend the FMP to change the value, whereas only stipulating the parameter allows the value to be changed automatically as new data become available. This is very likely the case of B_{virgin} for ocean quahogs.

‡ We note that National Standard 1 (600.310) does not requires management using both fishing and biomass targets (600.310 section c.6.1 and c.6.11), although this is certainly a recommended option for many fisheries, so that stipulating only B_{target} and $B_{threshold}$ at this time meets the requirements of National Standard 1.

* 22,000 Mt was specifically chosen to exceed the quota set this year to take into account possible increases in quota over the next decade.

∓ We have not included natural mortality, M, or recruitment, R, in this calculation; thus, a more precise estimate of time-till-$B_{60\%virgin}$ would vary somewhat from these estimates. However, we note that $M \approx R$ in the 1997 assessment, so that the values obtained from a more precise calculation should not vary much from these estimates.

F_{target} and $F_{threshold}$ when $B_t = B_{60\%virgin}$ anyway. Therefore, we prefer not to stipulate the form of F_{target} and $F_{threshold}$ at this time. Rather, we prefer that the FMP include the requirement that F_{target} and $F_{threshold}$ be set when $B_t = B_{60\%virgin}$.

5. Finally, we think that the Amendment language should note explicitly that evaluation of B_{msy} is based on the known biomass of the entire stock rather than an evaluation by region (e.g. NNJ, SNE, etc.).

Accordingly, we suggest that the two paragraphs on p. 4 of Amendment 12 for ocean quahogs read as follows:

> For MSY of ocean quahogs, it is assumed that MSY occurs at a B_{msy} that is one-half of the virgin biomass: $B_{msy} = \frac{B_{virgin}}{2}$. The 1997 surveyed biomass estimate is at about 80% of the known virgin biomass and is at a level that is > 80% of the virgin biomass for the stock. The overfishing "target" for ocean quahogs is B_{msy}, one-half the virgin biomass: $B_{target} = \frac{B_{virgin}}{2}$. The overfishing definition "threshold" is one-half B_{msy} [as recommended by Applegate et al. (1998) Overfishing Definition Review Panel report]: $B_{threshold} = \frac{B_{msy}}{2}$. As the stock remains well above B_{msy}, National Standard 1 does not require establishment of target and threshold fishing mortality rates (F_{target}, $F_{threshold}$) at this time; however, the FMP must be amended to establish target and threshold fishing mortality rates (F_{target}, $F_{threshold}$) when the stock biomass (B_t) falls to 60% of the virgin biomass ($B_{60\%virgin}$) [in accordance with recommendations in Applegate et al. (1998)].

Surf Clams

We direct our recommendations specifically to the two paragraphs on p. 4 of the amendment addressing overfishing definitions in surf clams. Should these recommendations be accepted, it would be necessary to modify other portions of the text of the amendment to bring them into agreement.

1. Amendment 12 presently stipulates that "the new overfishing definition 'target' for surfclams will be the 1997 biomass estimate for Northern New Jersey (NNJ) as a reasonable proxy for B_{msy} and the associated F_{P_0}." Two interpretations are possible for this recommendation, neither of which makes management sense. If B_{msy} is defined as the biomass for the area (NNJ), then the Amendment would permit the removal of the entire surf clam population outside NNJ (e.g. , SNE, LI, SNJ, DMV) without triggering B_{target} or $B_{threshold}$. If B_{msy} is defined in terms

of biomass per unit area (e.g., per square nautical mile), then the overfishing definition would prevent any fishing outside of NNJ. Approximate estimates of biomass per unit area for selected regions, taken from the Stock Assessment Review Committee Consensus Summary of Assessments for the 26^{th} SAW are: NNJ, 118 MT naut m^{-2}; DMV, 55 MT naut m^{-2}; GBK, 50 MT naut m^{-2}*. In fact, all areas except NNJ would have biomass levels below B_{target} and $B_{threshold}$. B_{1997} for these areas would immediately trigger the target overfishing definition and the threshold overfishing definition that would require $F \approx 0$ outside of NNJ. Moreover, if the resource is managed as one stock, the entire stock biomass would trigger B_{target} and $B_{threshold}$. Accordingly, we view it as essential to re-evaluate the recommended biomass and fishing thresholds.

2. We continue to agree with this year's stock assessment (1997 survey) which, in essence, evaluated the fishery by region by setting an F (F_{P_0}) such that the biomass removed from NNJ did not exceed the surplus production in that region. This was based on the clear indication from data analysis by Jim Weinberg at NMFS-NEFSC that population density and demographics varied significantly between regions; thus requiring a regional evaluation of population dynamics. We also agree with Amendment 12 as written that the biomass in NNJ is near B_{msy}, and note, therefore, that the management approach adopted this year is in conformance with the requirements of National Standard 1 for this region and the establishment of F_{target} as F_{P_0}.

3. However, we also believe that that the virgin biomass varies significantly between regions. The present wording in Amendment 12, p. 4, states that insufficient data are available to accurately determine B_{msy} based on B_{virgin}. We agree that this is true in NNJ and probably SNJ, SNE and LI. However, Weinberg's analysis of DMV certainly suggests that $B_{1997_{DMV}} \approx B_{virgin_{DMV}}$. Both the size-frequency distribution of the population and apparent growth rates suggest a population near carrying capacity off Delmarva. Although the detailed analyses have not been done, the information on size-frequency distributions from the Stock Assessment Review Committee Consensus Summary of Assessments for the 26^{th} SAW and the fact that fishing has not been significant for over a decade suggest that the Georges Bank population is also near carrying capacity☺. The

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* The surveyed area in GBK is relatively poorly known, because areas that cannot be sampled due to hard substrate or large boulders have not yet been deleted from the total area estimates. It is anticipated that this will be done by the next stock assessment.

☺ We note the similarity in size frequency distributions in DMV and GBK populations. However, it is conceivable that cold temperatures might restrict growth in GBK, so a further evaluation of these populations is warranted.

present density off NNJ, which is certainly below $B_{virgin_{NNJ}}$, is, by our crude assessment, higher than the density in either of these regions (DMV or GBK)[÷], suggesting substantial regional differences in the virgin biomass.

4. Based on 2 and 3, we recommend that the biomass target be defined as the 1997 biomass for the region, $B_{msy} \approx B_{1997}$, for the regions of NNJ, SNJ, SNE, and LI, following the basic premise and arguments as written in Amendment 12, but that $B_{1997} \approx B_{virgin}$ for DMV and GBK. In the latter two cases, B_{target} should be defined as in ocean quahogs: $B_{msy} = \frac{B_{virgin}}{2}$.

5. We recommend that the overfishing definitions for DMV and GBK be treated in a similar fashion to that recommended for ocean quahogs because these areas are at near-virgin biomass levels. Thus, an F above the F_{target} for these regions would be permissible (surplus production $P < 0$) and, in fact, warranted based on the present status of the stock. We recommend that F_{target} be set at F_{P_0} elsewhere to maintain B_t near B_{msy} in the remaining regions[○].

6. We note that reduction of biomass in DMV or GBK, in order to achieve MSY in those regions, may result in a negative surplus production estimate for the entire resource, assuming that $F_{target} = F_{P_0}$ in the remaining regions, and that this should be permissible within the FMP.

7. Finally, as with ocean quahogs, we strongly urge the MAFMC to delete from Amendment 12 all values for B and F, retaining only the parameter definitions. We believe it likely that these values will be updated in the future as new research from NMFS and other scientists becomes available. Inclusion of a value may result in the need to amend the FMP to change the value, whereas only stipulating the parameter allows the value to be changed automatically as new data become available. This will very likely be the case for B_{virgin} for some regional areas.

[÷] Our calculations are admittedly crude. Particularly, we are unable to delete from the denominator the area in each region uninhabited by the resource. Deletion of these areas would significantly alter estimated density, but not the conclusions regarding the relationship of 1997 biomass to virgin biomass in each region.

[○] We note that B for the resource will exceed B_{msy} since $B_{1997_{DMV}}, B_{1997_{GBK}} \approx B_{virgin_{DMV}}, B_{virgin_{GBK}}$ and so, if the resource is managed as one stock, an $F > F_{P_0}$ would be permissible overall. Viewed another way, F_{P_0} for the resource would probably allow $P < 0$ in some regions. We strongly advise that some thought be given to treating surf clam regions like mixed fishery stocks (600.310.c.8) which would allow B_t in certain regions to drop below B_{msy} but remain above $B_{threshold}$. We think this option should be evaluated at the next assessment.

Accordingly, we suggest that the two paragraphs on p. 4 of Amendment 12 for surf clams read as follows:

The biomass in the Georges Bank and Delmarva regions is near B_{virgin}. The present data are insufficient to estimate accurately B_{virgin} for the remaining areas, however demographic evidence, stable yields, and the rough equivalence of production in NNJ with harvests suggest that stock biomass (1997 survey) approximates one-half the virgin biomass level. Consequently, $B_{target} \cong B_{msy}$ can be defined as $\frac{B_{virgin}}{2}$ wherever B_{virgin} is known and as B_{1997} elsewhere. The overfishing definition associated with B_{target}, F_{target}, shall be F_{P_0} that balances production and loss in the region, except that a production level below replacement ($P < 0$) for the resource may be permitted to reduce regional biomass to near B_{msy} from unacceptably high levels ($B > B_{60\% virgin}$) by establishing a $P \ll 0$ for that region.

The overfishing definition "threshold" shall be $\frac{B_{msy}}{2}$ [as recommended by the Applegate et al. (1998) Overfishing Definition Review Panel report] with an $F_{20\% msp}$ level of fishing mortality that should not be exceeded in any region, except as a management tool to reduce local density to near-B_{msy}. The $F_{20\% msp}$ is the threshold level recommended by the NEFSC for Amendment 9 (MAFMC, 1996) and reviewed and approved by the MAFMC Scientific and Statistical Committee.

Other considerations

1. We urge that PSP monitoring be recommended on p. 85-86 as part of the discussion of harmful algal blooms.

2. The definition of EFH for ocean quahogs should note that "the present area defined by the top 90% of the area where ocean quahogs were caught in the NEFSC surf clam and ocean quahog dredge surveys" must be expanded to encompass the additional, mostly deeper water quahog resources suspected to be present off LI, SNE and GBK.

Sincerely,

Eric N. Powell
Director
Haskin Shellfish Research Laboratory

Cc. Nancy Targett
Tom Hoff
Roger Mann

FAX TRANSMISSION

J.H. MILES & COMPANY, INC.
P.O. BOX 178
NORFOLK, VA 23501
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FAX: 757-622-9261

To:	Christopher M. Moore Mid-Atlantic Fishery Management Council	**Date:**	September 24, 1998
Fax #:	(302) 674-5399	**Pages:**	This page plus two
From:	David Moore J.H. Miles & Co., Inc.		
Subject:	Amendment 12		

COMMENTS:

Dr Moore,

To follow is a letter that details our comments on amendment 12 to the Atlantic Surfclam and Ocean Quahog Fishery Management Plan.

This is being provided in response to the opportunity for public comment on this matter. An original is being sent via overnight courier today.

Regards,

DMoore

David E. Moore

J.H. MILES & CO., INC.
SEAFOOD
NORFOLK, VIRGINIA

GROWERS AND PACKERS OF
FRESH AND FROZEN SEAFOOD

September 24, 1998

Christopher M. Moore, Ph.D.
Acting Executive Director
Mid-Atlantic Fishery Management Council
Room 2115 Federal Building
300 South New Street
Dover, DE 19904-6790

Dear Dr. Moore,

The proposed Amendment 12 to the Atlantic Surfclam and Ocean Quahog Fishery Management Plan will not achieve its primary objective-protecting the Northern New Jersey resource. Instead, it will have the opposite result, it will cause additional fishing in that region.

The reason for this is that this amendment will reduce the surfclam quota as the entire quota will be based upon an area that accounts for only 36% of the entire biomass. Once the quota is reduced, the price of the clams will increase. As the price of clams increases, the processor's raw material cost will increase. To combat this, the processor has two options: increase the price to the consumer or become more productive.

To be able to successfully pass along a significant price increase to the consumer is not reality as the consumer has too many alternatives. For example, if the consumer's buy decision is to purchase clams versus another source of protein (such as chicken or beef), the consumer will choose the least expensive alternative.

The processor's second option is to become more productive. This means he must get more meat from each bushel shucked. In order to achieve this, the processor would only buy from boats that harvest clams from the region with the highest yields. This region has historically been the Northern New Jersey region. Clearly, this will intensify harvest activities in the very area you are attempting to protect.

In addition to forcing the processor to buy only from the boats that harvest Northern New Jersey clams, another result of this amendment would be to create a fluctuating price environment. This situation will hurt the overall industry as it will deny the processor the ability to increase (and possibly even maintain) clams' market share. For example, a company such as Long John Silvers would be unwilling to include clams on its menu if it could not reasonably project the financial benefit of doing so due to price uncertainties. As a result, it will look to more price stable alternatives and eliminate clams from its menu totally.

In summary, amendment 12 does not achieve your stated objectives:

Stabilization: Basing the overall quota on the Northern New Jersey region will not stabilize harvest rates throughout the management region. As I have shown, it will increase the harvest in Northern New Jersey.

Efficiency: This amendment prevents any growth of the industry (and could possibly result in a contraction of it). This will result in even more down time for harvesters and processors alike. In addition, it will also deny efficient utilization of non Northern New Jersey resources (areas such as Delmarva) as clams harvested from areas other than Northern New Jersey will be too expensive due to a lower yield.

Flexibility: This amendment will not provide any flexibility. Instead, it will result in a continual lowering of the quota as the Northern New Jersey resource shrinks.

The only way to achieve your objectives is to raise the quota to the level that the 1997 survey showed could be harvested sustainably in the future. This would reduce the price of clams which will enable processors to buy clams from regions with yields lower than those of Northern New Jersey. In addition, the lower raw material costs will result in a lower cost to the consumer. This lower cost would result in an increase in the sales of the final product as the demand for clams, as for other seafoods, is very price elastic.

In summary, I do agree with the concerns of the SARC committee that the Northern New Jersey region may be over fished. However, Amendment 12 is not the appropriate way to address this problem. Instead, it is best addressed through management measures currently at the councils disposal-specifically an increase in the quota.

Thank you for giving me the opportunity to present my views. If you have any questions, please call me at (757) 622-9264.

Sincerely,

John R. Miles

John R. Miles
President

APPENDIX 3. PROPOSED REGULATIONS

50 CFR PART 648

Fisheries of the Northeastern United States; Amendment 12 to the Atlantic Surfclam and Ocean Quahog Fishery Management Plan

1. Surfclams and ocean quahogs would be added to the species identified in section 648.5 (Operator permits), paragraph (a).

§ 648.76 Framework specifications.

(a) *Within season management action.* The Council may, at any time, initiate action to add or adjust management measures if it finds that action is necessary to meet or be consistent with the goals and objectives of the Surfclam and Ocean Quahog FMP.

(1) *Adjustment process.* After a management action has been initiated, the Council shall develop and analyze appropriate management actions over the span of at least two Council meetings. The Council shall provide the public with advance notice of the availability of both the proposals and the analysis and opportunity to comment on them prior to and at the second Council meeting. The Council's recommendation on adjustments or additions to management measures must come from one or more of the following categories: the overfishing definition (both the threshold and target levels), description and identification of EFH (and fishing gear management measures that impact EFH), habitat areas of particular concern, set aside quota for scientific research, vessel tracking system, and the optimum yield range.

(2) *MAFMC recommendation.* After developing management actions and receiving public testimony, the MAFMC shall make a recommendation to the Regional Administrator. The MAFMC's recommendation must include supporting rationale and, if management measures are recommended, an analysis of impacts and a recommendation to the Regional Administrator on whether to issue the management measures as a final rule. If the MAFMC recommends that the management measures should be issued as a final rule, the MAFMC must consider at least the following factors and provide support and analysis for each factor considered:

(I) Whether the availability of data on which the recommended management measures are based allows for adequate time to publish a proposed rule, and whether regulations have to be in place for an entire harvest/fishing season.

(ii) Whether there has been adequate notice and opportunity for participation by the public and members of the affected industry in the development of the MAFMC's recommended management measures.

(iii) Whether there is an immediate need to protect the resource.

(iv) Whether there will be a continuing evaluation of management measures adopted following their implementation as a final rule.

(3) *Regional Administrator action.* If the MAFMC's recommendation includes adjustments or additions to management measures and, after reviewing the MAFMC's recommendation and supporting information:

(I) If the Regional Administrator concurs with the MAFMC's recommended management measures and determines that the recommended management measures should be issued as a final rule based on the factors specified in paragraph (b)(2) of this section, the measures will be issued as a final rule in the Federal Register.

(ii) If the Regional Administrator concurs with the MAFMC's recommendation and determines that the recommended management measures should be published first as a proposed rule, the measures will be published as a proposed rule in the Federal Register. After additional public comment, if the Regional Administrator concurs with the MAFMC recommendation, the measures will be issued as a final rule in the Federal Register.

(iii) If the Regional Administrator does not concur, the MAFMC will be notified in writing of the reasons for the non-concurrence.

(b) *Emergency action*. Nothing in this section is meant to derogate from the authority of the Secretary to take emergency action under section 305(e) of the Magnuson-Stevens Act.