# Surfclam and Ocean Quahog Quota Specifications for 2004 Including: Draft Environmental Assessment, Regulatory Impact Review, Initial Regulatory Flexibility Analysis, and Essential Fish Habitat Assessment

**September 2003**

## Mid-Atlantic Fishery Management Council

**in cooperation with the**

## National Marine Fisheries Service

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# Executive Summary

This document provides a summary of relevant information for recommending quotas for surfclams (*Spisula solidissima*) and ocean quahogs (*Arctica islandica*) in Federal waters for 2004. Management responsibility for these two species resides with the Mid-Atlantic Fishery Management Council, based in Dover, Delaware. The management regime is detailed in the *Fishery Management Plan (FMP) for the Atlantic Surfclam and Ocean Quahog Fishery* and subsequent Amendments to the Plan. Amendment 8 provided the most substantial change in the management regime through introduction of Individual Transferable Quotas (ITQs), which replaced a complex system of time and effort restrictions. Amendment 10 was approved by the National Oceanic and Atmospheric Administration (NOAA) in May 1998, and provided more appropriate management measures for the small, artisanal fishery for ocean quahogs operating off of the northeast coast of Maine. Amendment 12 was partially approved in April 1999 and implements a new overfishing definition for ocean quahogs, identifies and describes essential fish habitat for both species, implements a framework adjustment process, and requires Operator Permits. A Proposed Rule for Amendment 13 was published in the Federal Register on Sept. 25, 2003 and would establish:

- a new surfclam overfishing definition
- multi-year fishing quotas
- a mandatory vessel monitoring system (VMS), when such a system is economically viable
- the ability to suspend or adjust the surfclam minimum size limit through a framework adjustment
- an analysis of fishing gear impacts on Essential Fish Habitat (EFH) for surfclams and ocean quahogs

The primary tool in the management of surfclams and ocean quahogs in Federal waters is the specification of annual quotas, which are allocated to the holders of allocation shares at the beginning of each calendar year. Until a multi-year quota provision is approved, the Mid-Atlantic Council is required to make annual recommendations to the Secretary of Commerce on the appropriate quotas for the upcoming year. This document provides a summary of the most recent information available concerning the biological status of these natural resources, and the commercial fisheries which utilize them. Several alternative quota scenarios for each species are proposed and evaluated. The Mid-Atlantic Council recommends increasing the Federal surfclam quota by 4.6%, increasing the ocean quahog quota outside Maine by 11.1%, maintaining the status quo quota for the Maine ocean quahog management area, and continuing the suspension of the surfclam size limit.

| **Quota Recommendations for the Year 2004** | |
|---|---|
| Surfclams | 3.4 million bushels |
| Ocean Quahogs | 5.00 million bushels |
| Maine Ocean Quahogs | 100,000 Maine bushels |

## Surfclam Overview

Surfclams are bivalve mollusks which are distributed in the western North Atlantic from the southern Gulf of St. Lawrence to Cape Hatteras. Commercial fisheries have generally concentrated on the populations of surfclams which have flourished in the sandy ocean sediments off the coast of New Jersey and the Delmarva peninsula. Growth rates are relatively rapid, with clams reaching the preferred harvest size (approximately 5 inches) in about six years. Maximum size is about 9 inches in length, though individuals larger than 8 inches are rare. They have a longevity of approximately 35 years, and while some individuals reach sexual maturity within three months, most spawn by the end of their second year.

In the Mid-Atlantic region, surfclams are found in the relatively shallow waters from the beach zone to a depth of about 180 feet. Substantial fisheries exist in the 3-mile jurisdictions of the States of New Jersey and New York.

Traditionally, surfclams' dominant use has been in the "strip market" to produce fried clams. In recent years, however, they have increasingly been used in chopped or ground form for other products, such as high-quality soups and chowders.

## Ocean Quahog Overview

Ocean quahogs are found in the colder waters on both sides of the North Atlantic. Off the United States and Canada, they range from Newfoundland to Cape Hatteras at depths from 25 feet to 750 feet. Industry has been pressing the limits of current technology in harvesting ocean quahogs as deep as 300 feet in the waters off southern New England. As one progresses northward, ocean quahogs inhabit waters closer to shore, such that the State of Maine has a small commercial fishery which includes beds within the State's 3-mile zone.

Ocean quahogs are one of the longest-living, slowest growing marine bivalves in the world. Under normal circumstances, they live to more than 100 years old. Ocean quahogs have been aged in excess of 200 years. The exceedingly slow growth rate has given rise to such descriptions as "living rocks," or "miniature redwood trees." They require roughly twenty years to grow to the sizes currently harvested by the industry (approximately 3 inches), and reach sexual maturity between 5 and 10 years of age.

Traditionally, the dominant use of ocean quahogs has been in such products as soups, chowders, and white sauces. Their small meat has a sharper taste and darker color than surfclams, which has not permitted their use in strip products or the higher-quality chowders. With their lower exvessel price (approximately $6.00 per bushel in 2002 for the full "lease plus harvest" value), ocean quahogs have historically been a bulk, low- priced food item. As in other fisheries such as Atlantic mackerel, the industrial ocean quahog fishery has only been viable when large quantities could be harvested quickly and efficiently. When catch rates fell below a certain point, vessels tended to shift their effort to higher-yielding areas.

The small-scale fishery for ocean quahogs in Maine provides a stark contrast to the industrial fishery that takes place off the coast of the mid-Atlantic states up to Massachusetts. Small vessels in the 35-45 ft range actively target smaller ocean quahogs for the fresh, half shell market. Most of the catch is trucked directly out of state and brings an exvessel price that ranges from $37 - $48 per Maine bushel.

**Key Aspects of the Surfclam and Ocean Quahog Fisheries**

There are a number of important aspects of the surfclam and ocean quahog fisheries that distinguish them from most other fisheries in the US, and around the world. In many ways, participants in the clam fisheries are fortunate in their ability to conduct their business operations efficiently and profitably, without many of the complications and liabilities experienced by most other fisheries.

**Resources Healthy - No Extreme Management Measures Necessary** The surfclam and ocean quahog resources are considered to be in overall good health. This condition negates the need for many of the harshest management measures, which can greatly reduce efficiency and profitability.

**Single Species Fisheries with No Significant Bycatch** Industry is able to harvest both surfclams and ocean quahogs individually, with no significant bycatch of any other species. This greatly simplifies management and reduces the need for gear restrictions to reduce the harvest of non-target species.

**No Interactions with Protected Species** The hydraulic dredge utilized by the clam industry is not known to have any measurable impacts on marine mammals, turtles, birds or other species protected by law.

**No Significant Gear Conflicts** There have been no reports of gear conflicts in Federal waters between clam fishermen utilizing hydraulic dredges and other types of fishing gear, whether mobile or stationary.

**No Significant Impacts on Essential Fisheries Habitat (EFH)** The prime habitat of surfclams and ocean quahogs consists of sandy substrates with little vegetation or benthic 'structures' that could be damaged by the passing of a hydraulic dredge. In these 'high energy' environments, it is thought that the recovery time following passage of a clam dredge is relatively short. Additionally, the overall area impacted by the clam fisheries is relatively small (approximately 100 square nautical miles), compared to the large area of high energy sand on the continental shelf. Any impacts to EFH are considered temporary and minimal.

**No Recreational Fisheries** There are no recreational fisheries for either Atlantic surfclams or ocean quahogs. Management efforts can focus solely on commercial harvests.

**Harvests Stable** Quota management utilizing ITQs in the Federal clam fisheries have allowed for relatively stable harvests over time.

**ITQ Management Promotes Efficiency and Profitability** Managing surfclams and ocean quahogs with tradeable shares of the annual quota has provided industry with enormous flexibility and removed all incentives for derby fishing. Vessel owners can readily plan to harvest their quota at any time throughout the year. Supply disruptions are eliminated when fishermen are no longer faced with closures imposed to prevent a seasonal, group quota from being exceeded. Profitability and efficiency are dramatically enhanced when unneeded vessels can be sold out of a fishery that has adopted ITQ management. Effort management systems which tie harvest rights to individual vessels make it difficult for excess capital to find more productive uses elsewhere in an economy.

**Reduced Enforcement Costs** A number of benefits were realized in the area of enforcement following the transition to ITQ management in 1990. Major cost savings resulted when enforcement activity shifted from watching vessels at sea with expensive Coast Guard cutters and aircraft to monitoring clam transportation containers on land. Incentives for cheating were drastically reduced once allocation holders were faced with the prospect of forfeiting the allocation itself for repeated violations. Additionally, the improved efficiency derived from ITQ management has improved the profitability of the clam industry as a whole. Consequently, is it less likely that industry members will feel compelled to break the law due to financial stress in their business operations.

## Quota Specifications

| Proposed 2004 Quota Alternatives for ITQ Fisheries | | | |
|---|---|---|---|
| **Surfclams** | | | |
| | Description | Quota (bushels) | % Change from 2003 |
| Alt. S1 | Min. Allowable | 1.850 million | 43.1% Decrease |
| Alt. S2 | Slight Decrease (2002 quota) | 3.135 million | 3.5% Decrease |
| Alt. S3 | Status Quo | 3.250 million | No Change |
| Alt. S4 | Slight Increase (half-way to max) | 3.325 million | 2.3% Increase |
| Alt. S5** | Max. Allowable | 3.400 million | 4.6% Increase |
| | | | |
| **Ocean Quahogs** | | | |
| Alt. Q1 | Min. Allowable | 4.000 million | 11.1% Decrease |
| Alt. Q2 | Partial Reduction | 4.250 million | 5.6% Decrease |
| Alt. Q3 | Status Quo | 4.500 million | No Change |
| Alt. Q4** | Increase | 5.000 million | 11.1% Increase |
| Alt. Q5 | Max. Allowable | 6.000 million | 33.3% Increase |
| ** Council Recommendation | | | |

| Proposed 2004 Quotas for Maine Ocean Quahog Fishery | | | |
|---|---|---|---|
| Alt. M1 | 50% of Max. Quota | 50,000 Maine Bu. | 50% Decrease |
| Alt. M2 | Status Quo less 2002 Quota Overage | 84,700 Maine Bu. | 18% Decrease |
| Alt. M3** | Max Allowable - Status Quo | 100,000 Maine Bu. | No Change |
| ** Council Recommendation | | | |

**Surfclam ITQ Quota Recommendation for 2004: 3.4 million bushels**

The Council staff identified five alternative quotas for the Council to consider for the year 2004. Since the 2003 quota of 3.25 million bushels is already relatively close to the maximum allowable of 3.40 million, the two alternatives which would increase the quota correspond to percentage increases of only 2.3% and 4.6%. The Council voted to recommend an increase of the full 4.6% to 3.4 millions bushels for the reasons discussed below.

The picture we have of the surfclam resource and fishery is complex, and has elements that can and do change from year to year. Yet the bottom line is that the best scientific advice we currently have indicates that an increase in the annual quota to the maximum OY level of 3.4 million bushels is sustainable. Our most recent biological assessment in 2003 indicated that the resource is composed of many age classes, is not overfished, and overfishing is not occurring.

There are a number of factors that argue for a cautious approach in the management of this resource in the years ahead. The most important of these include the steady decline in fleet LPUE that has accompanied the large, sustained harvests off New Jersey. Additionally, the lack of surfclam recruitment in the warmer inshore waters of New Jersey strongly suggest that future harvests from that resource area may have to be severely reduced.

Finally, there are significant uncertainties that remain in the biological assessments. Estimates of key parameters have experienced substantial variation between assessments. For example, the estimate of total biomass increased 27% from 1997 to 1999, and then plummeted 45% from 1999 to 2002. Additional data, time, and refinement of methods will be required to reduce that uncertainty in the future.

On a more encouraging note, the underutilization of the New York inshore surfclam quota has ended, and there have been at least anecdotal reports of new surfclam recruits in a number of areas, particularly off New York, and in deeper waters.

**Ocean Quahog ITQ Quota Recommendation for 2004: 5.0 million bushels**

The staff identified five alternative ocean quahog quotas for the Council to consider for2004. The Council voted to recommend Alternative Q4, an 11.1% increase to 5.0 million bushels. As with the recommendation for surfclams, the primary reason for the increase is that the best scientific advice currently available to the Council suggests that an increase is sustainable.

The staff believes that the life history of ocean quahogs warrants a particularly conservative approach in its management. As will be discussed in other sections, ocean quahogs are one of the longest-living, slowest growing marine bivalves in the world. Under normal circumstances, they live to more than 100 years old. The exceedingly slow growth rate has given rise to such descriptions as “living rocks,” or “miniature redwood trees.”

Research indicates that vast quantities of ocean quahogs remain in the ocean, in spite of decades of harvests that have removed many of the densest concentrations. A question that has vexed managers for years is at what point the remaining ocean quahog resources might become uneconomical to harvest, given the lower value they have historically commanded in the marketplace. Recent price increases and the deployment of efficient new vessels have served to allay these concerns for the time being.

Of additional concern has been the apparent lack of new recruitment to the population, as small ocean quahogs have not been seen in significant numbers in either scientific surveys or commercial catches. It has been hoped that this was due to the fact that the commercial fishing gear utilized to date has been intentionally configured to allow the smallest animals to pass through. For this reason, Dr. Eric Powell of Rutgers University conducted a recruitment survey in the summer of 2002 for ocean quahogs. While no analyses of the data have been completed or peer reviewed to date, Dr. Powell has provided verbal confirmation that his survey has encountered small ocean quahogs, with larger concentrations located in the areas off southern New England.

Hence, there have been some encouraging developments recently that would tend to support an increase in the ocean quahog quota, including the 2002 increase in average LPUE.

A final reason for the recommended increase is in response to the expected reduction of the surfclam quota in New Jersey state waters. Current indications are that the reduction may be severe, and the Council may wish to consider supporting increased access to ocean quahogs in an effort to maintain current supplies of clam meats as the industry adjusts to the change.

**Maine Ocean Quahog Quota Recommendation for 2004: 100,000 Maine bushels**

The Mid-Atlantic Council recommends that the Maine ocean quahog quota remain unchanged for 2004 at the initial maximum quota level of 100,000 Maine bushels (1 bushel = 1.2445 cubic feet). This quota pertains to the zone of both state and Federal waters off the eastern coast of Maine north of $43^{O}$ $50^{'}$ north latitude. Amendment 10 established management measures for this small artisanal fishery for ocean quahogs and was implemented in May of 1998.

Until a survey and assessment of the ocean quahog resource off Maine is completed and the maximum quota level may be adjusted, it is anticipated that some Maine fishermen will rent ITQ allocation after the 100,000 bushel quota is reached. Work on a survey and subsequent assessment has been initiated, and it is hoped that results will be available for setting the quota in 2005.

**Surfclam Size Limit Suspension**

The Mid-Atlantic Council is recommending that the minimum size limit on surfclams be suspended again in 2004, as it has been since implementation of Amendment 8 (MAFMC 1990). Current assessment information indicates that the stock is composed primarily of larger, adult animals in most areas. Reinstating a minimum size under these conditions would result in greater harm than benefit, as it would require the industry to use "sorting" machines which often damage/destroy undersized clams as it routes them back overboard.

Note: "status quo" corresponds to the "no action" alternative.

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# ENVIRONMENTAL ASSESSMENT

## 1.0 ANNUAL SPECIFICATION PROCESS

### 1.1 Introduction

This document provides a summary of relevant information for recommending quotas for surfclams (*Spisula solidissima*) and ocean quahogs (*Arctica islandica*) in Federal waters for 2004. Management responsibility for these two species resides with the Mid-Atlantic Fishery Management Council, based in Dover, Delaware. The management regime is detailed in the *Fishery Management Plan (FMP) for the Atlantic Surfclam and Ocean Quahog Fishery* and subsequent Amendments to the Plan. Amendment 8 (MAFMC 1990) provided the most substantial change in the management regime through introduction of Individual Transferable Quotas (ITQs), which replaced a complex system of time and effort restrictions. Amendment 10 (MAFMC 1998) was approved by the National Oceanic and Atmospheric Administration (NOAA) in May 1998, and provided more appropriate management measures for the small, artisanal fishery for ocean quahogs operating off of the northeast coast of Maine. Amendment 12 (MAFMC 1999) was partially approved in April 1999 and implements a new overfishing definition for ocean quahogs, identifies and describes essential fish habitat for both species, implements a framework adjustment process, and requires Operator Permits. Amendment 13 (MAFMC 2003c) was approved by the Council for public hearings at their April 2002 Council meeting with public hearings held in September and October of 2002. The final draft was adopted by the Council in January of 2003 and it has been in review by NMFS since June 2003. Amendment 13 is designed to address the disapproved surfclam overfishing definition, the disapproved fishing gear impacts to essential fish habitat (EFH) discussion, allow for multi-year quotas, allow for a vessel monitoring system (VMS) and add to the list of framework measures the suspension of the surfclam minimum size limit and adjustment of the minimum size.

The primary tool in the management of surfclams and ocean quahogs in Federal waters is the specification of annual quotas, which are allocated to the holders of allocation shares at the beginning of each calendar year. The Mid-Atlantic Council is required to make recommendations to Secretary of Commerce on the appropriate quotas for the upcoming year. This document provides a summary of the most recent information available concerning the biological status of these natural resources, and the commercial fisheries which utilize them. Several alternative quota scenarios for each species are proposed and evaluated. The Council recommends maintaining the status quo levels of 2003 for the Maine ocean quahog management areas, increasing the surfclam quota by roughly 4% to 3.40 million bushels, increasing the ocean quahog quota by roughly 11% to 5.0 million bushels, and continuing the suspension of the surfclam size limit.

This environmental assessment is undertaken to establish quotas for the 2004 Atlantic surfclam and ocean quahog fisheries. Biological assessments of these resources are conducted by the NMFS Northeast Region's Stock Assessment Workshop (SAW), which evaluates biological parameters such as overall population size, geographic distribution, age structure, and mortality rates from both natural causes and fishing activities. When the Council made their recommendations in June 2003, the most recent complete assessments were published in the Report of the 30th Northeast Regional Stock Assessment Workshop (USDC 2000a) for surfclams and the 31st Northeast Regional Stock Assessment Workshop (USDC 2000b) for ocean quahogs. These two assessments are based on the 1999 clam research survey. Copies of the 2000 assessments are available from the Northeast Fisheries Science Center (NEFSC). A clam survey was completed in July 2002 and the assessment for surfclams was conducted in the June 2003 stock assessment review committee (SARC). The Council did not have the benefit of that assessment for their June deliberations, however staff which had participated in the June SARC briefed the Council that the surfclam resource was not overfished and overfishing was not occurring. This document will not include the entire June 2003 SARC results because the Council did not have the benefit of the full document which was just presented to them at the August Council meeting. However, the 2003 assessment did not contradict the earlier assessment and will be alluded to in terms of the "state of the stock" and the "management advice" provided. The ocean quahogs are scheduled for assessment at the upcoming SARC in December of 2003.

## 1.2 Purpose and Need

The purpose for the action is to establish landing quotas for 2004 for both surfclams and ocean quahogs. Regulations implementing the FMP (50 CFR 648) provide that the Secretary of Commerce (Secretary) will annually specify the quotas. The quota range for surfclams is between 1,850,000 bushels and 3,400,000 bushels. The quota range for ocean quahogs is between 4,000,000 bushels and 6,000,000 bushels. The quota range for the Maine ocean quahog area (both state and Federal waters off the eastern coast of Maine north of 43$^{o}$ 50' north latitude) is between 17,000 and 100,000 bushels.

Prior to the beginning of each year, the Council, following an opportunity for public comment, recommends to the Secretary quotas within the ranges specified. In selecting the quotas the Council must consider current stock assessments, catch reports, and other relevant information concerning: exploitable and spawning biomass relative to the optimum yield; fishing mortality rates relative to the optimum yield; 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 or ocean quahog fishing that are to be opened during the year.

At the March 2000 Council meeting, the Council (after reviewing the 2000 surfclam assessment, USDC 2000a) passed a motion that, “given the recent stock assessment, we consider an increase in quota to the 3.4 million bushel OY over the next 5 years with a 10% increase the first year.”

The quota is set at that amount which is most consistent with the objectives of Amendment 8 of the Fishery Management Plan for the Atlantic Surfclam and Ocean Quahog Fishery (MAFMC 1990). The Secretary 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 Magnuson Act and the objectives of the Atlantic Surfclam and Ocean Quahog Fishery Management Plan.

The following table presents surfclam and ocean quahog quotas since 1990 and the year 2004 recommendation voted by the Mid-Atlantic Council in June 2003:

| | Surfclams (million bushels) | Ocean Quahogs (million bushels) |
|---|---|---|
| 1990 Quota | 2.850 | 5.300 |
| 1991 Quota | 2.850 | 5.300 |
| 1992 Quota | 2.850 | 5.300 |
| 1993 Quota | 2.850 | 5.400 |
| 1994 Quota | 2.850 | 5.400 |
| 1995 Quota | 2.565 | 4.900 |
| 1996 Quota | 2.565 | 4.450 |
| 1997 Quota | 2.565 | 4.317 |
| 1998 Quota | 2.565 | 4.000 |
| 1999 Quota | 2.565 | 4.500 |
| 2000 Quota | 2.565 | 4.500 |
| 2001 Quota | 2.850 | 4.500 |
| 2002 Quota | 3.135 | 4.500 |
| 2003 Quota | 3.250 | 4.500 |
| **2004 Recommendation** | **3.400** | **5.000** |

### 1.3 Management Objectives

The objectives of the FMP, since implementation of Amendment 8 (MAFMC 1990), have been and continue to be:

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 surfclam and ocean quahog management to minimize the government and private cost of administering and complying with regulatory, reporting, enforcement, and research requirements of surfclam and ocean quahog management.

3. Provide the opportunity for industry to operate efficiently, consistent with the conservation of surfclam and ocean 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.

### 1.4 Management Unit

The management unit is all Atlantic surfclams (*Spisula solidissima*) and ocean quahogs (*Arctica islandica*) in the Atlantic EEZ. In 1988 the American Malacological Union officially changed the common name of "surf clam" to the one word name "surfclam". This was published in the American Fisheries Society special publication 16 entitled *Common and Scientific Names of Aquatic Invertebrates from the United States and Canada: Mollusks* (AFS 1988). The ocean quahogs managed in this FMP include a small-scale fishery in eastern Maine that harvests small ocean quahogs which are generally sold for the half-shell market. Locally these small ocean quahogs off the coast of Maine are known as "mahogany quahogs" and have been under Council management since implementation of Amendment 10 (MAFMC 1998). There is no scientific question that the small scale Maine fishery occurs on *Arctica islandica.*

## 2.0 METHODS OF ANALYSIS

The basic approach adopted in this analysis is an assessment of various quotas and management measures from the standpoint of determining the impacts upon the environment. In order to conduct a more complete analysis, impacts were examined for the three quotas (surfclams, ocean quahogs, and Maine ocean quahogs) and for suspension of the minimum size limit for surfclams. The preferred alternatives examine the measures adopted by the Council in June 2003. Status quo alternatives were evaluated for all three quotas, as were the minimum and maximum allowed by the regulations. A full description of the alternatives is presented is section 3.0.

| Proposed 2004 Quota Alternatives | | | |
|---|---|---|---|
| **Surfclam** | | | |
| | Description | Quota (bushels) | % Change from 2003 |
| Alt. S1 | Min. Allowable | 1.850 million | 43.1% Decrease |
| Alt. S2 | Slight Decrease | 3.135 million | 3.5% Decrease |
| Alt. S3 | Status Quo | 3.250 million | No Change |
| Alt. S4 | Slight Increase | 3.325 million | 2.3% Increase |
| Alt. S5** | Max. Allowable | 3.400 million | 4.6% Increase |
| ** Council Recommendation | | | |
| **Ocean Quahog** | | | |
| Alt. Q1 | Min. Allowable | 4.000 million | 11.1% Decrease |
| Alt. Q2 | Partial Reduction | 4.250 million | 5.6% Decrease |
| Alt. Q3 | Status Quo | 4.500 million | No Change |
| Alt. Q4** | Increase | 5.000 million | 11.1% Increase |
| Alt. Q5 | Max. Allowable | 6.000 million | 33.3% Increase |
| ** Council Recommendation | | | |
| **Maine Ocean Quahog** | | | |
| Alt. M1 | 50% of Max. Quota | 50,000 Maine Bu. | 50% Decrease |
| Alt. M2 | Max less 2002 Over | 84,700 Maine Bu. | 18% Decrease |
| Alt. M3** | Max Allowable - Status Quo | 100,000 Maine Bu. | No Change |
| ** Council Recommendation | | | |

## 3.0 DESCRIPTION OF ALTERNATIVES BEING CONSIDERED

### 3.1 Surfclam *(Spisula solidissima)* Quota

#### 3.1.1 Preferred Alternative (S5) - 3.400 Million Bushels

The Council's preferred alternative quota for the 2004 surfclam fishery is 3.400 million bushels, which is a 4.6% increase from the 2003 quota of 3.250 million bushels. This preferred alternative meets the 2000 SAW recommendation: "Fishing mortality can be increased for the surfclam resource taken as a whole. However, it may be advantageous to avoid localized depletion." While the Council did not officially have the benefit of the June 2003 SARC report for their deliberations, they were aware that the management advice from that workshop was: "Although the stock is above Bmsy, uncertainty in the current level and future trend in biomass suggest that substantial increases in catch levels are not advised." (USDC 2003).

The most recent completed official biological assessments (from both the 1997 and 1999 surveys) indicate the resource is healthy, composed of many age classes, and can safely sustain increased harvests. Sufficient recruitment is also evident and thus this level of quota will not harm the long-term sustainability of the resource. The F in 2002 associated with a quota of 3.135 million bushels was approximately 0.03 and this quota increase will result in an F in 2004 of about 0.03 also.

The proposed quota takes into account analysis of surfclam abundance that was part of the 30th Northeast Regional Stock Assessment Workshop (SAW 30). SAW 30 utilized data from the 1999 surfclam survey, which included work to estimate dredge efficiency. Results from the 1999 survey and assessment corroborate those of the 1997 survey and assessment and provided the Council the opportunity to safely increase the quota. The Council has tentatively agreed with industry's request to continue increasing the quota up to the maximum optimum yield (3.4 million bushels) level set by the Plan. The Council will continue to perform its annual review of the fishery, and wants industry to understand that should future assessments continue to indicate the healthy status of the resource that the industry can plan for continuation of its maximum optimum yield level.

The Council continues to assume that none of the Georges Bank resource (approximately twenty percent of the total resource) will be available in the near future for harvesting because of paralytic shellfish poisoning. This area has been closed to the harvest of clams and other shellfish since 1990, and the Council and NMFS have no reason to believe that it will reopen in the near future.

#### 3.1.2 Alternative S1 - 1.850 Million Bushels

The first non-preferred alternative quota for the 2004 surfclam fishery is1.850 million bushels. This quota is within the OY range of between 1.850 and 3.400 million bushels as required by the FMP.

The 1.850 million bushel alternative for 2004 represents a decrease of 43.1% from the 3.250 million bushel quota which had been implemented in 2003. The direct impact would be that surfclam allocation owners would each receive 43.1% fewer cage tags than they had in 2003. All allocation owners would be affected proportionally the same, since the harvest right which each individual entity owns is actually a percentage share of the annual quota. If all other aspects of the surfclam fishery were to remain constant, such as ex-vessel prices and the quantity of surfclams supplied from state waters, then the major human consequence of the quota reduction is the near-term decrease in revenues which occurs from postponing a portion of the harvest of surfclams to a later year. It is unlikely, however that all the other conditions which held true previously will pertain again in 2004.

There is no major reason the Council would have considered seriously reducing the 2004 quota from the 2003, other than to evaluate the full range of alternatives.

In 2002, 100% of the EEZ quota was landed. Prior to 1997 the previous five years of the ITQ program landed between 99 and 100% of the quota annually, but during both 1997 and 1998 more than 5% of the quota was not landed. With the EEZ quota at a constant 2.565 million bushels for both 1997 and 1998, it is believed that market forces were the primary reason behind the EEZ landing decline. Also contributing to the conclusion for 1997 and 1998, that market demand was off was the fact that inshore New York and New Jersey landings were significantly below their quotas; however state landings have increased since 1999 (MAFMC 2003a).

A 43.1% reduction in quota for 2004 could possibly benefit the long-term sustainability of the resource, however there is the offsetting argument that the resource is considered under-exploited and the slow growing clams off of Delmarva may need to be thinned in order to be more productive. The 1998 assessment (USDC 1998a) states: "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." In addition, the annual impacts on bottom habitat may be slightly lessened with a reduction in quota.

Discounting the availability of the resource on Georges Bank, there is sufficient resource in the Northern New Jersey and Delmarva areas to maintain a quota significantly above this level. The biology of the resource does not warrant constraining the industry to this level at this time. This level of quota may not have significantly different effects on the resource (since more may die of natural mortality), but may have a somewhat more beneficial effect on bottom habitat than the preferred alternative. There would be less fishing effort with this alternative, but it has been determined that dredge impacts are short-term and minimal (section 7.5).

### 3.1.3 Alternative S2 -3.135 Million Bushels

The second non-preferred alternative quota for the 2004 surfclam fishery is the quota from 2002of 3.135 million bushels. This quota is within the OY range of between 1.850 and 3.400 million bushels as required by the FMP. This alternative would maintain the surfclam quota at the level it was in 2002 (MAFMC 2003a).

The 3.135 million bushel recommendation for 2004 represents the return to the 2002 quota and a decrease of 3.5% from 2003. The direct impact would be that surfclam allocation owners would continue to each receive the same number of cage tags they had in 2002. All allocation owners would be affected proportionally the same, since the harvest right which each individual entity owns is actually a percentage share of the annual quota. If all other aspects of the surfclam fishery were to remain constant, such as ex-vessel prices and the quantity of surfclams supplied from state waters, then there would be no major human consequences. It is unlikely, however that all the other conditions which held true in 2002 will pertain again in 2004.

The major reason the Council considered reinstating the status quo for the 2004 quota from the 2002 quota was in order to comply with Council policy about setting the quota to consider net economic benefits over time to consumers and producers, within the framework of greatest national benefit. Landings relative to quota for inshore New Jersey and New York were presented in the Quota Recommendation paper (MAFMC 2003a).

However, in 2002, 100% of the EEZ quota was landed. Prior to 1997 the previous five years of the ITQ program landed between 99 and 100% of the quota annually, but during both 1997 and 1998 more than 5% of the quota was not landed. With the EEZ quota at a constant 2.565 million bushels for each of those years, it is believed that market forces were the primary reason behind the EEZ landing decline. Also contributing to the conclusion that market demand was off was the fact that inshore New York and New Jersey landings were significantly below their quotas, however landings in New Jersey and New York both increased significantly since 1999 (MAFMC 2003a).

Returning to the quota level of 2002 could possibly affect the long-term growth of the industry, if industry is correct and the demand is growing. There is the argument that the slow growing clams off of Delmarva may need to be thinned in order to be more productive or may never become more productive. The assessment (USDC 1998a) states: "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." The annual impacts on bottom habitat would be the same with maintaining the quota. This level of quota could maintain exvessel prices, *ceteris paribus* (MAFMC 2003b).

### 3.1.4 Alternative S3 - No action - 3.250 Million Bushels

The third non-preferred alternative quota for the 2004 surfclam fishery is the status quo of 3.250 million bushels. This quota is within the OY range of between 1.850 and 3.400 million bushels as required by the FMP. This alternative would maintain the surfclam quota at the level it was in 2003 (MAFMC 2003a).

The 3.250 million bushel alternative for 2004 represents the status quo. The direct impact would be that surfclam allocation owners would continue to each receive the same number of cage tags they had the year before. All allocation owners would be affected proportionally the same, since the harvest right which each individual entity owns is actually a percentage share of the annual quota. If all other aspects of the surfclam fishery were to remain constant, such as ex-vessel prices and the quantity of surfclams supplied from state waters, then there would be no major human consequence of the status quo. It is unlikely, however that all the other conditions which held true in 2003 will pertain again in 2004.

The major reason the Council considered the status quo for the 2004 quota from the 2003 quota was in order to comply with Council policy about setting the quota to consider net economic benefits over time to consumers and producers, within the framework of greatest national benefit. Landings relative to quota for inshore New Jersey and New York were presented in the Quota Recommendation paper (MAFMC 2003a).

However, in 2002, 100% of the EEZ quota was landed. Prior to 1997 the previous five years of the ITQ program landed between 99 and 100% of the quota annually, but during both 1997 and 1998 more than 5% of the quota was not landed. With the EEZ quota at a constant 2.565 million bushels for each of those years, it is believed that market forces were the primary reason behind the EEZ landing decline. Also contributing to the conclusion that market demand was off was the fact that inshore New York and New Jersey landings were significantly below their quotas, however landings in New Jersey and New York both increased significantly since 1999 (MAFMC 2003a).

Maintaining the status quo quota for 2004 could possibly affect the long-term growth of the industry, if industry is correct and the demand is growing. There is the argument that the slow growing clams off of Delmarva may need to be thinned in order to be more productive or may never become more productive. The assessment (USDC 1998a) states: "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." The annual impacts on bottom habitat would be the same with maintaining the quota. This level of quota would maintain exvessel prices, *ceteris paribus* (MAFMC 2003b).

### 3.1.5 Alternative S4 - 3.325 Million Bushels

The Council's fourth non-preferred alternative quota for the 2004 surfclam fishery is 3.325 million bushels, which is a 2.3% increase from the 2003 quota of 3.250 million bushels. This non- referred alternative meets the 2000 SAW recommendation: "Fishing mortality can be increased for the surfclam resource taken as a whole. However, it may be advantageous to avoid localized depletion." While the Council did not officially have the benefit of the June 2003 SARC report for their deliberations, they were aware that the management advice from that workshop was: "Although the stock is above Bmsy, uncertainty in the current level and future trend in biomass suggest that substantial increases in catch levels are not advised." (USDC 2003).

The most recent completed official biological assessments (from both the 1997 and 1999 surveys) indicate the resource is healthy, composed of many age classes, and can safely sustain increased harvests. Sufficient recruitment is also evident and thus this level of quota will not harm the long-term sustainability of the resource. The F in 2002 associated with a quota of 3.135 million bushels was approximately 0.03 and this quota increase will result in an F in 2004 of about 0.03 also.

The proposed quota takes into account analysis of surfclam abundance that was part of the 30th Northeast Regional Stock Assessment Workshop (SAW 30). SAW 30 utilized data from the 1999 surfclam survey, which included work to estimate dredge efficiency. Results from the 1999 survey and assessment corroborate those of the 1997 survey and assessment and provided the Council the opportunity to safely increase the quota. The Council has tentatively agreed with industry's request to continue increasing the quota up to the maximum optimum yield (3.4 million bushels) level set by the Plan. The Council will continue to perform its annual review of the fishery, and wanted industry to understand that should future assessments continue to indicate the healthy status of the resource that the industry can plan for steady growth to its maximum optimum yield level.

The Council continues to assume that none of the Georges Bank resource (approximately twenty percent of the total resource) will be available in the near future because of paralytic shellfish poisoning (PSP). This area has been closed to the harvest of clams and other shellfish since 1990, and the Council and NMFS have no reason to believe that it will reopen soon.

The Sustainable Fisheries Act (SFA) of 1996 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 to suggest conservation and enhancement measures. These new habitat requirements, including what is known about clam gear impacts to the bottom, were addressed in Amendment 12 (MAFMC 1999) and more thoroughly in Amendment 13 (MAFMC 2003c) which has been submitted to the Secretary in June 2003.

## 3.2 Surfclam Minimum Size Limit

### 3.2.1 Preferred Alternative 1 (No action)

The Surfclam and Ocean Quahog FMP includes a provision for a minimum size limit of 4.75 inches on surfclams, which may be used to protect new year classes from harvest before they reach an optimal size. This provision is written such that the 4.75 inch minimum size will automatically be in effect unless the Council and NMFS take the active step of suspending it annually. The current stock is comprised of large, adult individuals, with few small individuals apparent from landings in most areas (USDC 2000a). Reinstating a minimum size under these conditions would result in greater harm than benefit, as it would require the industry to use "sorting" machines which will often damage undersized clams as it routes them back overboard.

It is, therefore, the Council's recommendation that the surfclam minimum size limit be suspended for 2004, as has been done every year since 1990. Continuing the suspension will have no impact on the current fishery or resource.

### 3.2.2 Alternative 2 (No suspension)

Alternative 2 would implement the reverse of Alternative 1, whereby there would be no provision to suspend the minimum surf clam size limit of 4.75 inches for surf clams. The Witzig 2001 report identifies that only 2 percent of the landed clams were smaller than 4.75 inches. It is believed that there is no current at sea discards. Survival rates of discarded clams is greater than 50 percent, so even if all the clams smaller than 4.75 inches were discarded, the result would only be about one percent of the annual landings. The most recent SARC (USDC 2000a) that the Council evaluated considers this resource as under-utilized, however the Council was aware that the June 2003 SARC, while not completed in time for their deliberations, did provide that the state of the stock in the EEZ, "is not overfished and overfishing is not occurring".

## 3.3 Ocean Quahog *(Arctica islandica)* Quota

### 3.3.1 Preferred Alternative (Q4) -- 5.000 Million Bushels

The Council proposes a 2004 ocean quahog quota of 5.000 million bushels, an increase over the previous quota during the past four years of 4.5 million bushels. There is no biological reason that the resource can not support this level of quota given the most recent stock assessments (USDC 1998b and 2000b). The 1997 (4.317 million bushels) and 1998 (4.000 million bushels) reductions were based on evaluation of the harvest level which would satisfy the previous Council policy of a harvest level which could be maintained for at least 30 years given the information prior to the 1998 assessment (USDC 1998b).

The Sustainable Fisheries Act (SFA) of 1996 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, including what little is known about clam gear impacts to the bottom, were addressed in Amendment 12 (MAFMC 1999) and the new Amendment 13 (USDC 2003c) that is in for Secretarial review. The effect on bottom habitat of the 5.000 million bushel quota may be slightly more than is currently occurring, but all the dredging impacts were considered temporary and minimal. This level of quota will not effect the exvessel market, *ceteris paribus*.

Based on the biological data presented in the most recent assessments (USDC 1998b and 2000b) the ocean quahog quota could have been increased overall. The Council proposed a 2004 ocean quahog quota based on the analysis of abundance for that species found in the 31st Northeast Regional Stock Assessment Workshop (SAW 31) concluded in August 2000. Similar to surfclams, SAW 31 and the assessment from the 1997 survey (SAW 27) included work to estimate dredge efficiency and showed a significant increase in the estimate of ocean quahog biomass. Although 36 percent of the resource is located on Georges Bank, SAW 31 did not question whether Georges Bank would ever be reopened. It is estimated the even excluding the ocean quahog resource portion on Georges Bank, that fully 82% of the virgin biomass remains after two plus decades of harvesting these long-lived creatures. The ocean quahog resource is scheduled for assessment at the 38th SARC in December 2003.

As with the recommendation for surfclams, the primary reason for the recommended increase is that the best scientific advice currently available to the Council suggests that such an increase would be sustainable.

The Council believes that the life history of ocean quahogs warrants a particularly conservative approach in its management. As will be discussed in other sections, ocean quahogs are one of the longest-living, slowest growing marine bivalves in the world. Under normal circumstances, they live to more than 100 years old. The exceedingly slow growth rate has given rise to such descriptions as “living rocks,” or “miniature redwood trees.”

Research indicates that vast quantities of ocean quahogs remain in the ocean, in spite of decades of harvests that have removed many of the densest concentrations. A question that has vexed managers for years is at what point the remaining ocean quahog resources might become uneconomical to harvest, given the lower value they have historically commanded in the marketplace. Recent price increases and the deployment of efficient new vessels have served to allay these concerns for the time being.

Of additional concern has been the apparent lack of new recruitment to the population, as small ocean quahogs have not been seen in significant numbers in either scientific surveys or commercial catches. It has been hoped that this was due to the fact that the commercial fishing gear utilized to date has been intentionally configured to allow the smallest animals to pass through. For this reason, Dr. Eric Powell of Rutgers University conducted a recruitment survey in the summer of 2002 for ocean quahogs. While no analyses of the data have been completed or peer reviewed to date, Dr. Powell has provided verbal confirmation that his survey has encountered small ocean quahogs, with larger concentrations located in the areas off southern New England.

Hence, there have been some encouraging developments recently that would tend to support an increase in the ocean quahog quota, including the 2002 increase in average landings per unit effort (LPUE).

A final reason for the recommended increase is in response to the expected reduction of the surfclam quota in New Jersey state waters. Current indications are that the reduction may be severe, and the Council may wish to consider supporting increased access to ocean quahogs in an effort to maintain current supplies of clam meats as the industry adjusts to the change.

The Secretary approved Amendment 12 (MAFMC 1999) with its overfishing definition in April 1999. The new definition has: a "biomass target" = ½ virgin biomass, "fishing mortality target" = $F_{0.1}$, "biomass threshold" = ½ biomass target, and a "fishing mortality threshold" = to $F_{25\%}$ MSP level yielding F = 0.04. The 1999 quota yielded an F (the last time it was measured at a peer-reviewed SARC) of approximately 0.02 compared to the threshold of 0.04 contained in the overfishing definition. The specific F associated with the 2004 quota is expected to be close to the F in 1999, because a similar proportion of the biomass remains unexploited 1999. Therefore, the proposed quota is below the approved overfishing definition for fishing mortality.

The 5.000 million bushel recommendation for 2004 is a slight increase over the previous four years. If accepted by the National Marine Fisheries Service (NMFS), the direct impact would be a slight (11.1%) increase over the status quo allocation issued to each allocation owner for 2003. There should be minimal change in economic impacts.

Increasing the ocean quahog quota to the 5.000 million bushel level relaxes the binding constraint which existed on the ocean quahog supply for 1997 and 1998 and places it at a level which industry members have stated will meet their needs. Given the reassuring news resulting from the latest stock assessments, many would find it unreasonable to restrain the supply of ocean quahogs at a time when the industry has a market for them, and both harvesting and processing capacity are not being fully utilized (MAFMC 2003b).

### 3.3.2 Alternative Q1 - 4.000 Million Bushels

The minimum quota allowed under the FMP's OY definition is the alternative for 4.000 million bushels, which was not chosen by the Council because it would be constraining to industry and there is no biological reason to constrain industry at this time. The 4.000 million bushel level is the level the Council selected in 1998 and was a reduction of 7.3 percent from 1997. With the 1997 and 1999 surveys and the 1998 and 2000 assessments showing that there is sufficient resource, the Council elected to have a slight increase for 1999 and maintain that level for 2000, 2001, 2002, and 2003, while now increasing it 11.1% to the recommended 5.0 million bushels.

The quota reductions which the Council recommended in 1997 and 1998 were in part due to questions about the validity of assuming that all of the Georges Bank biomass would become available to the fishery over the course of the 30 year harvest period. In 1996 when the Council made the assumption of a reopening occurring on Georges Bank, the Council stated that additional quota reductions would be necessary in the future if demonstrable progress was not made toward a reopening of Georges Bank in the near future. The 1996 SAW did not provide any forecast for ocean quahogs and only provided the management advice that a 30 - year supply is possible only if the biomass on Georges Bank and in areas off Southern New England and Long Island, generally too deep to be harvested with current technology, were included.

The 1998 and 2000 SAWs (USDC 1998b and 2000b) did not question whether Georges Bank would ever be opened. Fully more than a third of the resource is located on Georges Bank. The resource is of sufficient size overall that the third that is on Georges Bank is not necessary to meet the Council's former 30 supply year policy. This policy has now been replaced with the overfishing definition which is based on maximum sustainable yield (MSY) and a supply that is sustainable indefinitely.

As with the surfclam resource, the vast majority of ocean quahogs which are left unharvested in 2004 will still be available to the same allocation holders in subsequent years. Earnings are simply deferred rather than lost, with the ocean quahogs being stored in the ocean rather than in refrigerated containers or cans.

This minimal level of quota may have a slight beneficial effect on the resource since major recruitment incidents have not been identified for the ocean quahog stock, and these animals may take up to 20 years to reach marketable size depending upon environmental conditions. A return to the 1998 quota level may have a slight beneficial effect on the bottom habitat since less bottom would be exposed to the hydraulic dredging, especially in areas that have been heavily fished, however, it has been determined that clam dredge impacts are short-term and minimal. This level of quota will not likely affect the exvessel market, *ceteris paribus* (i.e., all other things being equal).

### 3.3.3 Alternative Q2 - 4.250 Million Bushels

Splitting the difference between the minimum allowable quota under the OY range and the current quota of 4.500 million bushels, yields a quota of 4.250 million bushels. This is a quota reduction of 5.6%. This level was not chosen by the Council because it could be constraining to industry, and there is no biological reason to constrain industry at this point. With the 1997 and 1999 surveys and 1998 and 2000 assessments showing that there is sufficient resource, the Council elected to have a slight increase for 1999, and maintain that level for 2000, 2001, 2002, and 2003, in order to allow the industry to grow. The recommended 2004 quota would allow the industry to continue to grow.

The quota reductions which the Council recommended in 1997 and 1998 were in part due to questions about the validity of assuming that all of the Georges Bank biomass would become available to the ocean quahog fishery over the course of the 30 year harvest period. In 1996 when the Council made the assumption of a reopening occurring on Georges Bank, the Council stated that additional quota reductions would be necessary in the future if demonstrable progress was not made toward a reopening of Georges Bank in the near future. The 1996 SAW did not provide any forecast for ocean quahogs and only provided the management advice that a 30 - year supply is possible only if the biomass on Georges Bank and in areas off Southern New England and Long Island, generally too deep to be harvested with current technology, are included.

The 1998 and 2000 SAWs (USDC 1998b and 2000b) did not question whether Georges Bank would ever be opened. Fully a third of the resource is located on Georges Bank. The resource is of sufficient size overall that the third of the resource that is on Georges Bank is not necessary to meet the Council's former 30 supply year policy, which has been supplanted by the new overfishing definition based on MSY.

As with the surfclam resource, the vast majority of ocean quahogs that are left unharvested in 2004 will still be available to the same allocation holders in subsequent years. Earnings are simply deferred rather than lost, with the ocean quahogs being stored in the ocean rather than in refrigerated containers or cans.

This level of quota may have a slight beneficial affect on the resource since major recruitment incidents have not been identified for the ocean quahog stock, and these animals may take up to 20 years to reach marketable size depending upon environmental conditions. A return to a level near the 1997 quota level may have a slightly higher beneficial effect on the bottom habitat since less bottom would be exposed to the hydraulic dredging, especially in areas that have been heavily fished. This level of quota will not likely effect the exvessel market, *ceteris paribus*.

### 3.3.4 Alternative Q3 - No action - 4.500 Million Bushels

Maintaining the status quo yields a quota of 4.500 million bushels. This level was not chosen by the Council because it could be constraining to industry and there is no biological reason to constrain industry at this point. With the 1997 and 1999 surveys and 1998 and 2000 assessments showing that there is sufficient resource, the Council elected to have a slight increase for 1999, and maintain that level for 2000, 2001, 2002, and 2003, in order to allow the industry to grow. The recommended 2004 quota would allow the industry to continue to grow. Industry believed that a continuation at this level would be constraining in 2004.

The quota reductions which the Council recommended in 1997 and 1998 were in part due to questions about the validity of assuming that all of the Georges Bank biomass would become available to the fishery over the course of the 30 year harvest period. In 1996 when the Council made the assumption of a reopening occurring on Georges Bank, the Council stated that additional quota reductions would be necessary in the future if demonstrable progress was not made toward a reopening of Georges Bank in the near future. The 1996 SAW did not provide any forecast for ocean quahogs and only provided the management advice that a 30 - year supply is possible only if the biomass on Georges Bank and in areas off Southern New England and Long Island, generally too deep to be harvested with current technology, are included.

The 1998 and 2000 SAWs (USDC 1998b and 2000b) did not question whether Georges Bank would ever be opened. Fully a third of the resource is located on Georges Bank. The resource is of sufficient size overall that the third of the resource that is on Georges Bank is not necessary to meet the Council's former 30 supply year policy, which has been supplanted by the new overfishing definition based on MSY.

As with the surfclam resource, the vast majority of ocean quahogs which are left unharvested in 2004 will still be available to the same allocation holders in subsequent years. Earnings are simply deferred rather than lost, with the ocean quahogs being stored in the ocean rather than in refrigerated containers or cans.

This level of quota should not have a negative or beneficial effect on the resource. This level of quota should not affect the exvessel market, *ceteris paribus*.

### 3.3.5 Alternative Q5 - 6.000 Million Bushels

This is the maximum of the OY range for ocean quahog quotas and would be a quota increase of 33.3% above the status quo. Bottom habitat may be more negatively impacted as roughly 33.3% more ocean quahogs would be removed. This large of an increase in quota would likely have a negative impact on prices.

## 3.4 Maine Ocean Quahog (*Arctica islandica)* Quota

### 3.4.1 Preferred Alternative (M3) – No action -- 100,000 Maine bushels

Three alternative quotas are presented for the Maine ocean quahog fishery. Alternative M3 would maintain the status quo quota at the maximum allowable level of 100,000 Maine bushels.

The Council recommends that the Maine ocean quahog quota for 2004 remain unchanged at the initial maximum quota of 100,000 Maine bushels (1 bushel = 1.2445 cubic feet).

The 2002 quota was projected to be reached by October 24, 2002, and the Regional Administrator closed this fishery on October 24, 2002, as she did for the 2000 Maine Mahogany fishery in November of 2000. It is anticipated that the Regional Administrator will likely also have to close the fishery in 2003. The Maine fishery was not closed in 2001 because of the quota being reached but was closed for nearly a month in the summer due to PSP. It is likely that this paralytic shellfish poisoning (PSP) closure during the peak of the season precluded a closure attributable to exceeding the annual quota.

According to 50 CFR section 648.76 (2)(b)(iv): *The Regional Administrator will monitor the quota based on dealer reports and other available information and shall determine the date when the quota will be harvested. NMFS shall publish notification in the Federal Register advising the public that, effective upon a specific date, the Maine mahogany quahog quota has been harvested and notifying vessel and dealer permit holders that no Maine mahogany quahog quota is available for the remainder of the year.*

It must also be remembered that according to 50 CFR section 648.76 (2)(b)(iii): *All mahogany quahogs landed by vessels fishing in the Maine mahogany quahog zone for an individual allocation of quahogs under section 648,70 will be counted against the ocean quahog allocation for which the vessel is fishing.* In other words, even after the initial maximum quota of 100,000 Maine bushels is harvested from the Maine mahogany ocean quahog zone (north of $43^{o}50^{'}$), vessels could obtain/use ITQ allocation and continue to fish in this zone. It is anticipated that some Maine fishermen will again rent ITQ allocation after the 100,000 bushel quota is reached in 2003 and 2004 as they have done for the past two years. More than half (4,530 bushels) of the 8,500 bushels that were above the 100,000 quota in 2001 were landed with an ITQ allocation. In 2000, there were 5,821 bushels landed with ITQ shares of the 20,767 bushels that exceeded the 100,000 bushel quota. There were no quota overages prior to 2000. Since implementation of Amendment 10 in 1998, approximately 70 % of the average annual landings have been reported as coming from state waters and 30% from Federal waters.

Amendment 10 (MAFMC 1998) emphasized that there had been no comprehensive, systematic survey or assessment of the ocean quahog resource in eastern Maine. It also emphasized that a full stock assessment of the Maine resource should be a priority to ensure that this segment of the fishery would have a sustainable future. The initial maximum quota for the Maine zone was to remain in effect until a resource survey and assessment was completed. The agreement at the time of Amendment 10 was that the State of Maine was to initiate a survey once the initial maximum quota of 100,000 bushels became constraining. There was an effort within the State of Maine to initiate an ocean quahog survey in 2002. Scott Feindel has been hired and is currently working with a commercial fishermen to survey the distribution of the resource along the Maine coast.

### 3.4.2 Alternative M1 – 50,000 Maine bushels

Alternative M1 corresponds to a 50% reduction from the maximum allowable quota under the current management plan. The status quo quota of 100,000 bushels was attained in both the 2002 and 2000 fishing years, and likely would have been attained in the 2001 fishing year had there been no closure due to PSP. Although the condition of the Maine mahogany ocean quahog is currently unknown, the ocean quahog fishery overall is not overfished and overfishing is not occurring. Therefore, until such time that additional information is provided for this fishery (a stock assessment should be available in two years), it would be constraining to the industry to reduce the harvest significantly below the status quo quota as proposed by this alternative.

### 3.4.3 Alternative M2 – 84,700 Maine bushels

Alternative M2 corresponds to the maximum harvest level minus the 2002 overage, and would reduce the allowable harvest by 18%. There is no real justification in the FMP or the regulations to subtract one year's overage from the next year's level of harvest. These Maine fishermen have worked hard to build the market and a stock assessment for this portion of the resource should be available in a few years.

## 4.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

### 4.1 Description and Identification of Essential Fish Habitat (EFH)

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 (Appendices 5 and 6 of Amendment 13) are considered the best scientific information available for EFH in order to meet National Standard 2 of the MSFCMA and were relied upon heavily in this section of both Amendment 12 and Amendment 13.

As defined in section 3 (10) of the MSFCMA, EFH 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 Amendment 13 as Tables 11and 12.

Amendment 12 (MAFMC 1999) identified and described essential fish habitat for surfclams and ocean quahogs in section 2.2.2. No new information exists that would provide the basis for changing the EFH identification and description that was developed in Amendment 12.

**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 (Figures 30 and 31 of Amendment 13). 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 (Figures 32 and 33 of Amendment 13). 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 $^{o}$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$^{o}$ 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 identified in Amendment 12 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. 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.

According to section 600.815 (a)(8), 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 did not recommend any portions of EFH as HAPC for surfclams or ocean quahogs in Amendment 12 and has no new information to warrant a change 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 (Amendment 13). The information in the EFH background documents appear inadequate at this time to put a high priority on any specific habitat.

### 4.2 Description of Protected Resources

There are numerous species which inhabit the environment within the management unit of this FMP that are afforded protection under the Endangered Species Act (ESA) of 1973 (i.e., for those designated as threatened or endangered) and/or the Marine Mammal Protection Act of 1972 (MMPA). Eleven are classified as endangered or threatened under the ESA, while the remainder are protected by the provisions of the MMPA. The Council has determined that the following list of species protected either by the Endangered Species Act of 1973 (ESA), the Marine Mammal Protection Act of 1972 (MMPA), or the Migratory Bird Act of 1918 may be found in the environment utilized by Atlantic surfclam and ocean quahog fisheries:

**Cetaceans**

| Species | Status |
|---|---|
| Northern right whale (*Eubalaena glacialis*) | Endangered |
| Humpback whale (*Megaptera novaeangliae*) | Endangered |
| Fin whale (*Balaenoptera physalus*) | Endangered |
| Blue whale (*Balaenoptera musculus*) | Endangered |
| Sei whale (*Balaenoptera borealis*) | Endangered |
| Sperm whale (*Physeter macrocephalus* | Endangered |
| Minke whale (*Balaenoptera acutorostrata*) | Protected |
| Beaked whales (*Ziphius and Mesoplodon spp.*) | Protected |
| Risso's dolphin (*Grampus griseus*) | Protected |
| Pilot whale (*Globicephala spp.*) | Protected |
| White-sided dolphin (*Lagenorhynchus acutus*) | Protected |
| Common dolphin (*Delphinus delphis*) | Protected |
| Spotted and striped dolphins (*Stenella spp.*) | Protected |
| Bottlenose dolphin (*Tursiops truncatus*) | Protected |

**Sea Turtles**

| Species | Status |
|---|---|
| Leatherback sea turtle (*Dermochelys coriacea*) | Endangered |
| Kemp's ridley sea turtle (*Lepidochelys kempii*) | Endangered |
| Green sea turtle (*Chelonia mydas*) | Endangered |
| Hawksbill sea turtle (*Eretmochelys imbricata*) | Endangered |
| Loggerhead sea turtle (*Caretta caretta*) | Threatened |

**Fish**

| Species | Status |
|---|---|
| Shortnose sturgeon (*Acipenser brevirostrum*) | Endangered |
| Atlantic salmon (*Salmo salar*) | Endangered |

**Birds**

| Species | Status |
|---|---|
| Roseate tern (*Sterna dougallii dougallii*) | Endangered |
| Piping plover (*Charadrius melodus*) | Endangered |

**Critical Habitat Designations**

| Species | Area |
|---|---|
| Right whale | Cape Cod Bay |

The status of these and other marine mammal populations inhabiting the Northwest Atlantic has been discussed in detail in the U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments. Initial assessments were presented in Blaylock *et al.* (1995) and are updated in Waring *et al.* (1999). The most recent information on the stock assessment of various mammals can be found at: *www.nmfs.noaa.gov/prot_res/PR2/Stock_Assessment_program/sars.html.*

Two other useful websites on marine mammals are:
*www.nmfs.noaa.gov/prot_res/PR3/recovery.html and*
*http://spo.nwr.noaa.gov/mfr611/mfr611.htm.*

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 118 of the Marine Mammal Protection Act (MMPA) of 1972. In addition, the proposed actions will not increase fishing effort. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery.

The range of surfclams, ocean quahogs, and the above marine mammals and endangered species overlap 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 abundances. The Council does not believe that implementation of these quotas will have any adverse impact upon these populations. While marine mammals and endangered species may occur near surfclam and ocean quahogs beds, it is highly unlikely any significant conflict between the fishermen managed by this FMP and these species would occur. Clam 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 mostly pelagic and spend nearly all of their time up in the water column or near the surface as do, of course, seabirds.

**Description of Species Listed as Endangered which inhabit the management unit of the FMP**

**North Atlantic Right Whale**

Right whales have occurred historically in all the world's oceans from temperate to subarctic latitudes. NMFS recognizes three major subdivisions of right whales: North Pacific, North

Atlantic, and Southern Hemisphere. NMFS further recognizes two extant subunits in the North Atlantic: eastern and western. A third subunit may have existed in the central Atlantic (migrating from east of Greenland to the Azores or Bermuda), but this stock appears to be extinct (Waring *et al.* 2002).

The north Atlantic right whale has the highest risk of extinction among all of the large whales in the worlds oceans. The scarcity of right whales is the result of an 800-year history of whaling that continued into the 1960s (Klumov 1962). Historical records indicate that right whales were subject to commercial whaling in the North Atlantic as early as 1059. Between the $11^{th}$ and $17^{th}$ centuries, an estimated 25,000-40,000 right whales may have been harvested. The size of the western north Atlantic right whale population at the termination of whaling is unknown, but the stock was recognized as seriously depleted as early as 1750. However, right whales continued to be taken in shore-based operations or opportunistically by whalers in search of other species as late as the 1920's. By the time the species was internationally protected in 1935, there may have been fewer than 100 western north Atlantic right whales in the western Atlantic (Hain 1975; Reeves *et al.* 1992; Waring *et al.* 2002).

Right whales appear to prefer shallow coastal waters, but their distribution is also strongly correlated to the distribution of their prey (zooplankton). In both the northern and southern hemispheres, right whales are observed in the lower latitudes and more coastal waters during winter where calving takes place, and then tend to migrate to higher latitudes during the summer. The distribution of right whales in summer and fall in both hemispheres appears linked to the distribution of their principal zooplankton prey (Winn *et al.* 1986). They generally occur in Northwest Atlantic waters west of the Gulf Stream and are most commonly associated with cooler waters (21° C). They are not found in the Caribbean and have been recorded only rarely in the Gulf of Mexico.

Right whales feed on zooplankton through the water column, and in shallow waters may feed near the bottom. In the Gulf of Maine they have been observed feeding on zooplankton, primarily copepods, by skimming at or below the water's surface with open mouths (NMFS 1991b; Kenney *et al.* 1986; Murison and Gaskin 1989; and Mayo and Marx 1990). Research suggests that right whales must locate and exploit extremely dense patches of zooplankton to feed efficiently (Waring *et al.* 2000). New England waters include important foraging habitat for right whales and at least some portion of the North Atlantic right whale population is present in these waters throughout most months of the year. They are most abundant in Cape Cod Bay between February and April (Hamilton and Mayo 1990; Schevill *et al.* 1986; Watkins and Schevill 1982) and in the Great South Channel in May and June ( Payne *et al.* 1990) where they have been observed feeding predominantly on copepods, largely of the genera *Calanus* and *Pseudocalanus* (Waring *et al.* 2002). Right whales also frequent Stellwagen Bank and Jeffrey's Ledge, as well as Canadian waters including the Bay of Fundy and Browns and Baccaro Banks, in the spring and summer months. Mid-Atlantic waters are used as a migratory pathway from the spring and summer feeding/nursery areas to the winter calving grounds off the coast of Georgia and Florida.

NMFS designated right whale critical habitat on June 3, 1994 (59 FR 28793) to help protect important right whale foraging and calving areas within the U.S. These include the waters of Cape Cod Bay and the Great South Channel off the coast of Massachusetts, and waters off the coasts of southern Georgia and northern Florida. In 1993, Canada's Department of Fisheries declared two conservation areas for right whales; one in the Grand Manan Basin in the lower

Bay of Fundy, and a second in Roseway Basin between Browns and Baccaro Banks (Canadian Recovery Plan for the North Atlantic Right Whale 2000).

The northern right whale was listed as endangered throughout it's range on June 2, 1970 under the ESA. The current population is considered to be at a low level and the species remains designated as endangered (Waring *et al.* 2002). A Recovery plan has been published and currently is in effect (NMFS 1991). This is a strategic stock because the average annual fishery-related mortality and serious injury from all fisheries exceeds the Potential Biological Removal (PBR).

The western North Atlantic population of right whales was estimated to be 291 individuals in 1998 (Waring *et al.* 2002). The current population growth rate of 2.5% as reported by Knowlton *et al.* (1994) suggests the stock may be showing signs of slow recovery. The best available information makes it reasonable to conclude that the current death rate exceeds the birth rate in the western North Atlantic right whale population. The nearly complete reproductive failure in this population from 1993 to 1995 and again in 1998 and 1999 suggests that this pattern has continued for almost a decade, though the 2000/2001 season appears the most promising in the past 5 years, in terms of calves born. Because no population can sustain a high death rate and low birth rate indefinitely, this combination places the North Atlantic right whale population at high risk of extinction. Coupled with an increasing calving interval, the relatively large number of young right whales (0-4 years) and adults that are killed, by human-related factors, the likelihood of extinction is high. The recent increase in births gives rise to optimism, however these young animals must be provided with protection so that they can mature and contribute to future generations in order to be a factor in stabilizing of the population.

Right whales may be adversely affected by habitat degradation, habitat exclusion, acoustic trauma, harassment, or reduction in prey resources due to trophic effects resulting from a variety of activities including the operation of commercial fisheries. However, the major known sources of anthropogenic mortality and injury of right whales clearly are ship strikes and entanglement in commercial fishing gear. Waring *et al. (* 2002) give a detailed description of the annual human related mortalities of right whales.

**Humpback Whale**

The humpback whale was listed as endangered throughout it's range on June 2, 1970. This species is the fourth most numerically depleted large cetacean worldwide. Humpback whales calve and mate in the West Indies and migrate to feeding areas in the northwestern Atlantic during the summer months. Six separate feeding areas are utilized in northern waters after their return (Waring *et al.* 2002). Only one of these feeding areas, the GOM, lies within U.S. waters and is within the action area of this consultation. Most of the humpbacks that forage in the GOM visit Stellwagen Bank and the waters of Massachusetts and Cape Cod Bays. Sightings are most frequent from mid-March through November between 41º N and 43º N, from the Great South Channel north along the outside of Cape Cod to Stellwagen Bank and Jeffreys Ledge (CeTAP 1982), and peak in May and August. Small numbers of individuals may be present in this area year-round. They feed on a number of species of small schooling fishes, particularly sand lance and Atlantic herring, by targeting fish schools and filtering large amounts of water for their associated prey. Humpback whales have also been observed feeding on krill (Wynne and Schwartz 1999).

Various papers (Barlow & Clapham 1997; Clapham *et al.* 1999) summarized information gathered from a catalogue of photographs of 643 individuals from the western North Atlantic population of humpback whales. These photographs identified reproductively mature western North Atlantic humpbacks wintering in tropical breeding grounds in the Antilles, primarily on Silver and Navidad Banks, north of the Dominican Republic. The primary winter range also includes the Virgin Islands and Puerto Rico (Waring *et al.* 2002). In general, it is believed that calving and copulation take place on the winter range. Calves are born from December through March and are about 4 meters at birth. Sexually mature females give birth approximately every 2 to 3 years. Sexual maturity is reached between 4 and 6 years of age for females and between 7 and 15 years for males. Size at maturity is about 12 meters.

Humpback whales use the mid-Atlantic as a migratory pathway, but it may also be an important feeding area for juveniles. Since 1989, observations of juvenile humpbacks in the mid-Atlantic have been increasing during the winter months, peaking January through March (Swingle *et al.* 1993). Biologists speculate that non-reproductive animals may be establishing a winter feeding range in the mid-Atlantic since they are not participating in reproductive behavior in the Caribbean. Swingle *et al.* (1993) identified a shift in distribution of juvenile humpback whales in the nearshore waters of Virginia, primarily in winter months. Those whales using this mid-Atlantic area that have been identified were found to be residents of the GOM and Atlantic Canada (Gulf of St. Lawrence and Newfoundland) feeding groups, suggesting a mixing of different feeding stocks in the mid-Atlantic region. A shift in distribution may be related to winter prey availability. Studies conducted by the Virginia Marine Science Museum indicate that these whales are feeding on, among other things, bay anchovies and menhaden. In concert with the increase in mid-Atlantic whale sightings, strandings of humpback whales have increased between New Jersey and Florida since 1985. Strandings were most frequent during September through April in North Carolina and Virginia waters, and were composed primarily of juvenile humpback whales of no more than 11 meters in length (Wiley *et al.* 1995). Six of 18 humpbacks for which the cause of mortality was determined were killed by vessel strikes. An additional humpback had scars and bone fractures indicative of a previous vessel strike that may have contributed to the whale's mortality. Sixty percent of those mortalities that were closely investigated showed signs of entanglement or vessel collision.

New information has recently become available on the status and trends of the humpback whale population in the North Atlantic. Although current and maximum net productivity rates are unknown at this time, the population is apparently increasing. It has not yet been determined whether this increase is uniform across all six feeding stocks (Waring *et al.* 2002). For example, the overall rate of increase has been estimated at 9.0% (CV=0.25) by Katona and Beard (1990), while a 6.5% rate was reported for the Gulf of Maine by Barlow and Clapham (1997) using data through 1991. The rate reported by Barlow and Clapham (1997) may roughly approximate the rate of increase for the portion of the population within the action area.

Estimating abundance for the Gulf of Maine stock has proved problematic. Three approaches have been investigated: mark-recapture estimates, minimum population size, and line-transect estimates. Most of the mark recapture estimates were affected by heterogeneity of sampling, which was heavily focused on the southwestern Gulf of Maine. However, an estimate of 652 (CV=0.29) derived from the more extensive and representative YONAH sampling in 1992 and 1993 was probably less subject to this bias. The second approach uses photo-identification data to establish the minimum number of humpback whales known to be alive in a particular year, 1997. By determining the number of identified individuals seen either in that year, or in both a previous and subsequent year, it is possible to determine that at least 497 humpbacks were alive in 1997. This figure is also likely to be negatively biased, again because of heterogeneity of sampling. A similar calculation for 1992 (which would correspond to the YONAH estimate for the Gulf of Maine) yields a figure of 501 whales (Waring *et al.* 2002).

In the third approach, data were used from a 28 July to 31 August 1999 line-transect sighting survey conducted by a ship and airplane covering waters from Georges Bank to the mouth of the Gulf of St. Lawrence. Total track line length was 8,212 km. However, in light of the information on stock identity of Scotian Shelf humpback whales noted above, only the portions of the survey covering the Gulf of Maine were used; surveys blocks along the eastern coast of Nova Scotia were excluded. Shipboard data were analyzed using the modified direct duplicate method (Palka 1995) that accounts for school size bias and g(0), the probability of detecting a group on the track line. Aerial data were not corrected for g(0) (Palka 2000). These surveys yielded an estimate of 816 humpbacks (CV = 0.45). However, given that the rate of exchange between the Gulf of Maine and both the Scotian Shelf and mid-Atlantic region is not zero, this estimate is likely to be somewhat conservative. Accordingly, inclusion of data from 25% of the Scotian Shelf survey area (to reflect the match rate of 25% between the Scotian Shelf and the Gulf of Maine) gives an estimate of 902 whales (CV=0.41). Since the mark-recapture figures for abundance and minimum population size given above falls above the lower bound of the CV of the line transect estimate, and given the known exchange between the Gulf of Maine and the Scotian Shelf, we have chosen to use the latter as the best estimate of abundance for Gulf of Maine humpback whales (Waring *et al.* 2002).

The minimum population estimate is the lower limit of the two-tailed 60% confidence interval of the lognormally distributed best abundance estimate. This is equivalent to the 20th percentile of the log-normal distribution as specified by Wade and Angliss (1997). The best estimate of abundance for Gulf of Maine humpback whales is 902 (CV=0.41). The minimum population estimate for this stock is 647 (Waring *et al.* 2002).

As detailed below, current data suggest that the Gulf of Maine humpback whale stock is steadily increasing in size. This is consistent with an estimated average trend of 3.2% (SE=0.005) in the North Atlantic population overall for the period 1979–1993 (Stevick *et al.* 2001), although there are no other feeding-area-specific estimates. Barlow and Clapham (1997) applied an interbirth interval model to photographic mark-recapture data and estimated the population growth rate of the Gulf of Maine humpback whale stock at 6.5% (CV=0.012). Maximum net productivity is unknown for this population, although a theoretical maximum for any humpback population can be calculated using known values for biological parameters (Brandão *et al.* 2000, Clapham *et al.* 2001b). For the Gulf of Maine, data supplied by Barlow and Clapham (1997) and Clapham *et al.* (1995) gives values of 0.96 for survival rate, 6y as mean age at first parturition, 0.5 as the proportion of females, and 0.42 for annual pregnancy rate. From this, a maximum population growth rate of 0.072 is obtained according to the method described by Brandão et al. (2000). This suggests that the observed rate of 6.5% (Barlow and Clapham 1997) was close to the maximum for this stock. Clapham *et al.* (2001a) updated the Barlow and Clapham (1997) analysis using data from the period 1992 to 2000. The estimate was either 0% (for a calf survival rate of 0.51) or 4.0% (for a calf survival rate of 0.875). Although confidence limits are not available (because maturation parameters could not be estimated), both estimates of population growth rate are outside the 95% confidence intervals of the previous estimate of 6.5% for the period 1979 to 1991 (Barlow and Clapham 1997). It is unclear whether this apparent decline is an artifact resulting from a shift in distribution; indeed, such a shift occurred during exactly the period (1992-95) in which survival rates declined. It is possible that this shift resulted in calves born in those years imprinting on (and thus subsequently returning to) areas other than those in which intensive sampling occurs. If the decline is a real phenomenon it may be related to known high mortality among young-of-the-year whales in the waters of the U.S. mid-Atlantic states. However, calf survival appears to have increased since 1996, presumably accompanied by an increase in population growth. In light of the uncertainty accompanying the more recent estimate of population growth rate for the Gulf of Maine, for purposes of this assessment the maximum net productivity rate was assumed to be the default value for cetaceans of 0.04 (Barlow et al. 1995). Current and maximum net productivity rates are unknown for the North Atlantic population overall (Waring *et al.* 2002). As noted above, Stevick et al. (2001) calculated an average population growth rate of 3.2% (SE=0.005) for the period 1979–1993.

Potential Biological Removal (PBR) is the product of minimum population size, one-half the maximum productivity rate, and a "recovery" factor (MMPA Sec. 3. 16 U.S.C. 1362; Wade and Angliss 1997). The minimum population size is 647 . The maximum productivity rate is the default value of 0.04. The "recovery" factor, which accounts for endangered, depleted, threatened stocks, or stocks of unknown status relative to optimum sustainable population (OSP) is assumed to be 0.10 because this stock is listed as an endangered species under the Endangered Species Act (ESA). PBR for the Gulf of Maine humpback whale stock is 1.3 whales (Waring *et al.* 2002).

The major known sources of anthropogenic mortality and injury of humpback whales include entanglement in commercial fishing gear and ship strikes. Based on photographs of the caudal peduncle of humpback whales, Robbins and Mattila (1999) estimated that at least 48% --- and possibly as many as 78% --- of animals in the Gulf of Maine exhibit scarring caused by entanglement. Several whales have apparently been entangled on more than one occasion. These estimates are based on sightings of free-swimming animals that initially survive the encounter. Because some whales may drown immediately, the actual number of interactions may be higher. In addition, the actual number of species-gear interactions is contingent on the intensity of observations from aerial and ship surveys.

For the period 1996 through 2000, the total estimated human-caused mortality and serious injury to the Gulf of Maine humpback whale stock is estimated as 3.0 per year (USA waters, 2.4; Canadian waters, 0.6). This average is derived from two components: 1) incidental fishery interaction records, 2.8 (USA waters, 2.2; Canadian waters, 0.6); and 2) records of vessel collisions, 0.2 (USA waters, 0.2; Canadian waters, 0). There were additional humpback mortalities and serious injuries that occurred in the southeastern and mid-Atlantic states that could not be confirmed as involving members of the Gulf of Maine stock (Waring *et al.* 2002). These records represent an additional minimum annual average of 1.6 human-caused mortalities and serious injuries to humpbacks over the time period, of which 1.0 per year are attributable to incidental fishery interactions and 0.6 per year are attributable to vessel collisions (Waring *et al.* 2002).

As with right whales, human impacts (vessel collisions and entanglements) are factors which may be slowing recovery of the humpback whale population. There is an average of four to six entanglements of humpback whales a year in waters of the southern Gulf of Maine and additional reports of vessel-collision scars (unpublished data, Center for Coastal Studies). Of 20 dead humpback whales (principally in the mid-Atlantic, where decomposition did not preclude examination for human impacts), Wiley et al. (1995) reported that 6 (30%) had major injuries possibly attributable to ship strikes, and 5 (25%) had injuries consistent with possible entanglement in fishing gear. One whale displayed scars that may have been caused by both ship strike and entanglement. Thus, 60% of the whale carcasses which were suitable for examination showed signs that anthropogenic factors may have contributed to, or been responsible for, their death. Wiley et al. (1995) further reported that all stranded animals were sexually immature, suggesting a winter or migratory segregation and/or that juvenile animals are more susceptible to human impacts.

An updated analysis of humpback whale mortalities from the mid-Atlantic states region has recently been produced by Barco *et al.* (2001). Between 1990 and 2000, there were 52 known humpback whale mortalities in the waters of the U.S. mid-Atlantic states (summarized by Barco *et al.* 2001). Length data from 48 of these whales (18 females, 22 males and 8 of unknown sex) suggested that 39 (81.2%) were first-year animals, 7 (14.6%) were immature and 2 (4.2%) were adults. However, sighting histories of 5 of the dead whales indicate that some were small for their age, and histories of live whales further indicate that the population contains a greater percentage of mature animals than is suggested by the stranded sample. In their study of entanglement rates estimated from caudal peduncle scars, Robbins and Mattila (2001) found that males were more likely to be entangled than females. The scarring data also suggested that yearlings were more likely than other age classes to be involved in entanglements. Finally, female humpbacks showing evidence of prior entanglements produced significantly fewer calves, suggesting that entanglement may significantly impact reproductive success. Humpback whale entanglements also occur in relatively high numbers in Canadian waters. Reports of collisions with fixed fishing gear set for groundfish around Newfoundland averaged 365 annually from 1979 to 1987 (range 174-813). An average of 50 humpback whale entanglements (range 26-66) were reported annually between 1979 and 1988, and 12 of 66 humpback whales that were entangled in 1988 died (Lien et al. 1988). Volgenau et al. (1995) also summarized existing data and concluded that in Newfoundland and Labrador, cod traps caused the most entanglements and entanglement mortalities (21%) of humpbacks between 1979 and 1992. They also reported that gillnets are the gear that has been the primary cause of entanglements and entanglement mortalities (20%) of humpbacks in the Gulf of Maine between 1975 and 1990.

Humpback whales may also be adversely affected by habitat degradation, habitat exclusion, acoustic trauma, harassment, or reduction in prey resources due to trophic effects resulting from a variety of activities including the operation of commercial fisheries.

**Fin Whale**

Fin whales inhabit a wide range of latitudes between 20-75/ N and 20-75/ S (Perry *et al.* 1999). Fin whales spend the summer feeding in the relatively high latitudes of both hemispheres, particularly along the cold eastern boundary currents in the North Atlantic and North Pacific Oceans and in Antarctic waters (IWC 1992). Most migrate seasonally from relatively high-latitude Arctic and Antarctic feeding areas in the summer to relatively low-latitude breeding and calving areas in the winter (Perry *et al.* 1999).

As in the case of right and humpback whales, fin whale populations were heavily affected by commercial whaling. However, commercial exploitation of fin whales occurred much later than for right and humpback whales. Although some fin whales were taken as early as the 17$^{th}$ century by the Japanese using a fairly primitive open-water netting technique (Perry *et al.* 1999) and were hunted occasionally by sailing vessel whalers in the 19th century (Mitchell and Reeves 1983), wide-scale commercial exploitation of fin whales did not occur until the 20th century when the use of steam power and harpoon- gun technology made exploitation of this faster, more offshore species feasible. In the southern hemisphere, over 700,000 fin whales were landed in the 20th century. More than 48,000 fin whales were taken in the North Atlantic between 1860 and 1970 (Perry *et al.* 1999). Fisheries existed off of Newfoundland, Nova Scotia, Norway, Iceland, the Faroe Islands, Svalbard (Spitsbergen), the islands of the British coasts, Spain and Portugal. Fin whales were rarely taken in U.S. waters, except when they ventured near the shores of Provincetown, MA, during the late 1800's (Perry *et al.* 1999).

Various estimates have been provided to describe the current status of fin whales in western North Atlantic waters. Based on the catch history and trends in Catch Per Unit Effort, an estimate of 3,590 to 6,300 fin whales was obtained for the entire western North Atlantic (Perry *et al.* 1999). Hain *et al.* (1992) estimated that about 5,000 fin whales inhabit the Northeastern United States continental shelf waters. The latest (Waring *et al.* 2002) SAR gives a best estimate of abundance for fin whales of 2,814 (CV = 0.21). The minimum population estimate for the western North Atlantic fin whale is 2,362. This is currently an underestimate, as too little is known about population structure, and the estimate is derived from surveys over a limited portion of the western North Atlantic. There is also not enough information to estimate population trends.

In the North Atlantic today, fin whales are widespread and occur from the Gulf of Mexico and Mediterranean Sea northward to the edges of the arctic pack ice (Waring *et al.* 2002). A number of researchers have suggested the existence of fin whale subpopulations in the North Atlantic. Mizroch *et al.* (1984) suggested that local depletions resulting from commercial overharvesting supported the existence of North Atlantic fin whale subpopulations. Others have used genetics information to provide support for the belief that there are several subpopulations of fin whales in the North Atlantic and Mediterranean (Bérubé *et al.* 1998). In 1976, the IWC's Scientific Committee proposed seven stocks for North Atlantic fin whales. These are: (1) North Norway; (2) West Norway-Faroe Islands; (3) British Isles-Spain and Portugal; (4) East Greenland-Iceland; (5) West Greenland; (6) Newfoundland-Labrador; and (7) Nova Scotia (Perry *et al.* 1999). However, it is uncertain whether these stock boundaries define biologically isolated units (Waring *et al.* 2002). The NMFS has designated one stock of fin whale for U.S. waters of the North Atlantic where the species is commonly found from Cape Hatteras northward.

During 1978-1982 aerial surveys, fin whales accounted for 24% of all cetaceans and 46% of all large cetaceans sighted over the continental shelf between Cape Hatteras and Nova Scotia (Waring *et al.* 1998). Underwater listening systems have also demonstrated that the fin whale is the most acoustically common whale species heard in the North Atlantic (Clark 1995). The single most important area for this species appeared to be from the Great South Channel, along the 50 meter isobath past Cape Cod, over Stellwagen Bank, and past Cape Ann to Jeffrey's Ledge (Hain *et al.* 1992).

Despite our broad knowledge of fin whales, less is known about their life history as compared to right and humpback whales. Age at sexual maturity for both sexes ranges from 5-15 years. Physical maturity is reached at 20-30 years. Conception occurs during a 5 month winter period in either hemisphere. After a 12 month gestation, a single calf is born. The calf is weaned between 6 and 11 months after birth. The mean calving interval is 2.7 years, with a range of between 2 and 3 years (Agler *et al.* 1993). Like right and humpback whales, fin whales are believed to use northwestern North Atlantic waters primarily for feeding and migrate to more southern waters for calving. However, the overall pattern of fin whale movement consists of a less obvious north-south pattern of migration than that of right and humpback whales. Based on acoustic recordings from hydrophone arrays, Clark (1995) reported a general pattern of fin whale movements in the fall from the Labrador/Newfoundland region, south past Bermuda, and into the West Indies. However, evidence regarding where the majority of fin whales winter, calve, and mate is still scarce. Some populations seem to move with the seasons (e.g., one moving south in winter to occupy the summer range of another), but there is much structuring in fin whale populations that what animals of different sex and age class do is not at all clear. Neonate strandings along the U.S. mid-Atlantic coast from October through January suggest the possibility of an offshore calving area.

The overall distribution of fin whales may be based on prey availability. This species preys opportunistically on both invertebrates and fish. The predominant prey of fin whales varies greatly in different geographical areas depending on what is locally available. In the western North Atlantic fin whales feed on a variety of small schooling fish (i.e., herring, capelin, sand lance) as well as squid and planktonic crustaceans. As with humpback whales, fin whales feed by filtering large volumes of water for their prey through their baleen plates. Photo identification studies in western North Atlantic feeding areas, particularly in Massachusetts Bay, have shown a high rate of annual return by fin whales, both within years and between years (Seipt *et al.* 1990).

As discussed above, fin whales were the focus of commercial whaling, primarily in the $20^{th}$ century. The IWC did not begin to manage commercial whaling of fin whales in the North Atlantic until 1976. In 1987, fin whales were given total protection in the North Atlantic with the exception of a subsistence whaling hunt for Greenland. The IWC set a catch limit of 19 whales for the years 1995-1997 in West Greenland. All other fin whale stocks had a zero catch limit for these same years. However, Iceland reported a catch of 136 whales in the 1988/89 and 1989/90 seasons, and has since ceased reporting fin whale kills to the IWC (Perry *et al.* 1999). In total, there have been 239 reported kills of fin whales from the North Atlantic from 1988 to 1995.

The major known sources of anthropogenic mortality and injury of fin whales include ship strikes and entanglement in commercial fishing gear. However, many of the reports of mortality cannot be attributed to a particular source. Of 18 fin whale mortality records collected between 1991 and 1995, four were associated with vessel interactions, although the proximal cause of mortality was not known. The following injury/mortality events are those reported from 1996 to the present for which source was determined. These numbers should be viewed as absolute minimum numbers; the total number of mortalities and injuries cannot be estimated but is believed to be higher since it is unlikely that all carcasses will be observed. In general, known mortalities of fin whales are less than those recorded for right and humpback whales. This may be due in part to the more offshore distribution of fin whales where they are either less likely to encounter entangling gear, or are less likely to be noticed when gear entanglements or vessel strikes do occur. Fin whales may also be adversely affected by habitat degradation, habitat exclusion, acoustic trauma, harassment, or reduction in prey resources due to trophic effects resulting from a variety of activities including the operation of commercial fisheries. The fin whale was listed as endangered throughout it’s range on June 2, 1970 under the ESA.
Hain *et al.* (1992) estimated that about 5,000 fin whales inhabit the northeastern United States continental shelf waters. Waring *et al.* 2002 present a more recent estimate of 2,814 (CV=0.21)

fin whales based on aerial and shipboard surveys of the area from Georges Bank to the mouth of the Gulf of S. Lawrence in 1999.

**Sei Whale**

Sei whales are a widespread species in the world's temperate, subpolar and subtropical and even tropical marine waters. However, they appear to be more restricted to temperate waters than other balaenopterids (Perry *et al.* 1999). The IWC recognized three stocks in the North Atlantic based on past whaling operations as opposed to biological information: (1) Nova Scotia; (2) Iceland Denmark Strait; (3) Northeast Atlantic (Donovan 1991 *in* Perry *et al.* 1999). Mitchell and Chapman (1977) suggested that the sei whale population in the western North Atlantic consists of two stocks, a Nova Scotian Shelf stock and a Labrador Sea stock. The Nova Scotian Shelf stock includes the continental shelf waters of the northeastern United States, and extends northeastward to south of Newfoundland. The IWC boundaries for this stock are from the U.S. east coast to Cape Breton, Nova Scotia and east to longitude 42/ (Waring *et al.* 2002). This is the only sei whale stock within the action area.

Sei whales became the target of modern commercial whalers primarily in the late 19$^{th}$ and early 20$^{th}$ century after stocks of other whales, including right, humpback, fin and blues, had already been depleted. Sei whales were taken in large numbers by Norway and Scotland from the beginning of modern whaling. More than 700 sei whales were killed off of Norway in 1885, alone. Small numbers were also taken off of Spain, Portugal and in the Strait of Gibraltar beginning in the 1920's, and by Norwegian and Danish whalers off of West Greenland from the 1920's to 1950's (Perry *et al.* 1999). In the western North Atlantic, sei whales were originally hunted off of Norway and Iceland, but from 1967-1972, sei whales were also taken off of Nova Scotia (Perry *et al.* 1999). A total of 825 sei whales were taken on the Scotian Shelf between 1966-1972, and an additional 16 were taken from the same area during the same time by a shore based Newfoundland whaling station (Perry *et al.* 1999). The species continued to be exploited in Iceland until 1986 even though measures to stop whaling of sei whales in other areas had been put into place in the 1970's (Perry *et al.* 1999). There is no estimate for the abundance of sei whales prior to commercial whaling. Based on whaling records, approximately14,295 sei whales were taken in the entire North Atlantic from 1885 to 1984 (Perry *et al.* 1999).

Sei whales winter in warm temperate or subtropical waters and summer in more northern latitudes. In the northern Atlantic, most births occur in November and December when the whales are on the wintering grounds. Conception is believed to occur in December and January. Gestation lasts for 12 months and the calf is weaned at 6-9 months when the whales are on the summer feeding grounds. Sei whales reach sexual maturity at 5-15 years of age. The calving interval is believed to be 2-3 years (Perry *et al.* 1999).

Sei whales occur in deep water throughout their range, typically over the continental slope or in basins situated between banks. In the northwest Atlantic, the whales travel along the eastern Canadian coast in autumn, June and July on their way to and from the Gulf of Maine and Georges Bank where they occur in winter and spring. Within the action area, the sei whale is most common on Georges Bank and into the Gulf of Maine/Bay of Fundy region during spring and summer, primarily in deeper waters. Individuals may range as far south as North Carolina. It is important to note that sei whales are known for inhabiting an area for weeks at a time then disappearing for year or even decades; this has been observed all over the world, including in the southwestern GOM in 1986. The basis for this phenomenon is not clear.

Although sei whales may prey upon small schooling fish and squid in the action area, available information suggests that calanoid copepods and euphausiids are the primary prey of this species. There are occasional influxes of sei whales further into Gulf of Maine waters, presumably in conjunction with years of high copepod abundance inshore. Sei whales are occasionally seen feeding in association with right whales in the southern Gulf of Maine and in the Bay of Fundy. However, there is no evidence to demonstrate interspecific competition between these species for food resources. There is very little information on natural mortality factors for sei whales. Possible causes of natural mortality, particularly for young, old or otherwise compromised individuals are shark attacks, killer whale attacks, and endoparasitic helminths. Baleen loss has been observed in California sei whales, presumably as a result of an unknown disease (Perry *et al.* 1999).

There are insufficient data to determine trends of the sei whale population. Because there are no abundance estimates within the last 10 years, a minimum population estimate cannot be determined for NMFS management purposes (Waring *et al.* 2002). Abundance surveys are problematic not only because this species is difficult to distinguish from the fin whale but more significant is that too little is known of the sei whale's distribution, population structure and patterns of movement; thus survey design and data interpretation are very difficult.

Few instances of injury or mortality of sei whales due to entanglement or vessel strikes have been recorded in U.S. waters. Entanglement is not known to impact this species in the U.S. Atlantic, possibly because sei whales typically inhabit waters further offshore than most commercial fishing operations, or perhaps entanglements do occur but are less likely to be observed. A small number of ship strikes of this species have been recorded. The most recent documented incident occurred in 1994 when a carcass was brought in on the bow of a container ship in Charlestown, Massachusetts. Other impacts noted above for other baleen whales may also occur. Due to the deep-water distribution of this species, interactions that do occur are less likely to be observed or reported than those involving right, humpback, and fin whales that often frequent areas within the continental shelf (Waring *et al.* 2002).

**Blue Whale**

Like the fin whale, blue whales occur worldwide and are believed to follow a similar migration pattern from northern summering grounds to more southern wintering areas (Perry *et al.* 1999). Three subspecies have been identified: *Balaenoptera musculus musculus, B.m. intermedia*, and *B.m. brevicauda* (Waring *et al.* 2002). Only *B. musculus* occurs in the northern hemisphere. Blue whales range in the North Atlantic extends from the subtropics to Baffin Bay and the Greenland Sea . The IWC currently recognizes these whales as one stock (Perry *et al.* 1999).

Blue whales were intensively hunted in all of the world's oceans from the turn of the century to the mid-1960's. Blue whales were occasionally hunted by sailing vessel whalers in the $19^{th}$ century. However, development of steam-powered vessels and deck-mounted harpoon guns in the late $19^{th}$ century made it possible to exploit them on an industrial scale. Blue whale populations declined worldwide as the new technology spread and began to receive widespread use (Perry *et al.* 1999). Subsequently, the whaling industry shifted effort away from declining blue whale stocks and targeted other large species, such as fin whales, and then resumed hunting for blue whales when the species appeared to be more abundant (Perry *et al.* 1999). The result was a cyclical rise and fall, leading to severe depletion of blue whale stocks worldwide (Perry *et al.* 1999). In the North Atlantic, Norway shifted operations to fin whales as early as 1882 due to the scarcity of blue whales (Perry *et al.* 1999). In all, at least 11,000 blue whales were taken in the North Atlantic from the late 19th century through the mid-20th century. Blue whales were given complete protection in the North Atlantic in 1955 under the International Convention for the Regulation of Whaling. However, Iceland continued to hunt blue whales until 1960. There are no good estimates of the pre-exploitation size of the western North Atlantic blue whale stock but it is widely believed that this stock was severely depleted by the time legal protection was introduced in 1955 (Perry *et al.* 1999). Mitchell (1974) suggested that the stock numbered in the very low hundreds during the late 1960's through early 1970's (Perry *et al.* 1999). Photo-identification studies of blue whales in the Gulf of St. Lawrence from 1979 to 1995 identified 320 individual whales. The NMFS recognizes a minimum population estimate of 308 blue whales for the western North Atlantic (Waring *et al.* 2002).

Blue whales are only occasional visitors to east coast U.S. waters. They are more commonly found in Canadian waters, particularly the Gulf of St. Lawrence where they are present for most of the year, and other areas of the North Atlantic. It is assumed that blue whale distribution is governed largely by food requirements. In the Gulf of St. Lawrence, blue whales appear to predominantly feed on *Thysanoessa raschii* and *Meganytiphanes norvegica*. In the eastern North Atlantic, *T. inermis* and *M. norvegica* appear to be the predominant prey.

Compared to the other species of large whales, relatively little is known about this species. Sexual maturity is believed to occur in both sexes at 5-15 years of age. Gestation lasts 10-12 months and calves nurse for 6-7 months. The average calving interval is estimated to be 2-3 years. Birth and mating both take place in the winter season, but the location of wintering areas is speculative (Perry *et al.* 1999). In 1992 the U.S. Navy and contractors conducted an extensive blue whale acoustic survey of the North Atlantic and found concentrations of blue whales on the Grand Banks and west of the British Isles. One whale was tracked for 43 days during which time it traveled 1,400 nautical miles around the general area of Bermuda (Perry *et al.* 1999).

There is limited information on the factors affecting natural mortality of blue whales in the North Atlantic. Ice entrapment is known to kill and seriously injure some blue whales, particularly along the southwest coast of Newfoundland, during late winter and early spring. Habitat degradation has been suggested as possibly affecting blue whales such as in the St. Lawrence River and the Gulf of St. Lawrence where habitat has been degraded by acoustic and chemical pollution. However, there is no data to confirm that blue whales have been affected by such habitat changes (Perry *et al.* 1999).

Entanglement in fishing gear and ship strikes are believed to be the major sources of anthropogenic mortality and injury of blue whales. However, confirmed deaths or serious injuries from either are few. In 1987, concurrent with an unusual influx of blue whales into the Gulf of Maine, one report was received from a whale watch boat that spotted a blue whale in the southern Gulf of Maine entangled in gear described as probable lobster pot gear. A second animal found in the Gulf of St. Lawrence apparently died from the effects of an entanglement. In March 1998, a juvenile male blue whale was carried into Rhode Island waters on the bow of a tanker. The cause of death was determined to be due to a ship strike, although not necessarily caused by the tanker on which it was observed, and the strike may have occurred outside the U.S. EEZ (Waring *et al.* 2002). No recent entanglements of blue whales have been reported from the U.S. Atlantic. Other impacts noted above for other baleen whales may occur.

**Sperm Whale**

Sperm whales inhabit all ocean basins, from equatorial waters to the polar regions (Perry *et al.* 1999). In the western North Atlantic they range from Greenland to the Gulf of Mexico and the Caribbean. The sperm whales that occur in the western North Atlantic are believed to represent only a portion of the total stock (Blaylock *et al.* 1995). Total numbers of sperm whales off the USA or Canadian Atlantic coast are unknown, although eight estimates from selected regions of the habitat do exist for select time periods. The best estimate of abundance for the North Atlantic stock of sperm whales is 4,702 (CV=0.36) (Waring *et al.* 2002). The minimum population estimate for the western North Atlantic sperm whale is 3,505 (CV=0.36). Sperm whales present in the Gulf of Mexico are considered by some researchers to be endemic, and represent a separate stock from whales in other portions of the North Atlantic. However, NMFS currently uses the IWC stock structure guidance which recognizes one stock for the entire North Atlantic (Waring *et al.* 2002).

The International Whaling Commission estimates that nearly a quarter-million sperm whales were killed worldwide in whaling activities between 1800 and 1900 (IWC 1971). However, estimates of the number of sperm whales taken during this time are difficult to quantify since sperm whale catches from the early 19$^{th}$ century through the early 20$^{th}$ century were calculated on barrels of oil produced per whale rather than the actual number of whales caught (Perry *et al.* 1999). With the advent of modern whaling the larger rorqual whales were targeted. However as their numbers decreased, greater attention was paid to smaller rorquals and sperm whales. From 1910 to 1982 there were nearly 700,000 sperm whales killed worldwide from whaling activities (Clarke 1954). Whale catches for the southern hemisphere is 394,000 (including revised Soviet figures). Sperm whales were hunted in America from the 17th century through the early 20$^{th}$ century. In the North Atlantic, hunting occurred off of Iceland, Norway, the Faroe Islands, coastal Britain, West Greenland, Nova Scotia, Newfoundland/Labrador, New England, the Azores, Madeira, Spain, and Spanish Morocco (Waring *et al.* 1998). Some whales were also taken off the U.S. Mid-Atlantic coast (Reeves and Mitchell 1988; Perry *et al.* 1999), and in the northern Gulf of Mexico (Perry *et al.* 1999). There are no catch estimates available for the number of sperm whales caught during U.S. operations (Perry *et al.* 1999). Recorded North Atlantic sperm whale catch numbers for Canada and Norway from 1904 to 1972 total 1,995. All killing of sperm whales was banned by the IWC in 1988. However, at the 2000 meetings of the IWC, Japan indicated it would include the take of sperm whales in its scientific research whaling operations. Although this action was disapproved of by the IWC, Japan has reported the take of 5 sperm whales from the North Pacific as a result of this research.

Sperm whales generally occur in waters greater than 180 meters in depth. While they may be encountered almost anywhere on the high seas, their distribution shows a preference for continental margins, sea mounts, and areas of upwelling, where food is abundant (Leatherwood and Reeves 1983). Sperm whales in both hemispheres migrate to higher latitudes in the summer for feeding and return to lower latitude waters in the winter where mating and calving occur. Mature males typically range to much higher latitudes than mature females and immature animals but return to the lower latitudes in the winter to breed (Perry *et al.* 1999). Waring *et al.* (2002) suggest sperm whale distribution is closely correlated with the Gulf Stream edge. Like swordfish, which feed on similar prey, sperm whales migrate to higher latitudes during summer months, when they are concentrated east and northeast of Cape Hatteras. In the U.S. EEZ, sperm whales occur on the continental shelf edge, over the continental slope, and into the mid-ocean regions , and are distributed in a distinct seasonal cycle; concentrated east-northeast of Cape

Hatteras in winter and shifting northward in spring when whales are found throughout the mid-Atlantic Bight. Distribution extends further northward to areas north of Georges Bank and the Northeast Channel region in summer and then south of New England in fall, back to the mid-Atlantic Bight (Waring *et al.* 2002).

Sperm whale distribution may be linked to their social structure as well as distribution of their prey (Waring *et al.* 2002). Sperm whale populations are organized into two types of groupings: breeding schools and bachelor schools. Older males are often solitary (Best 1979). Breeding schools consist of females of all ages, calves and juvenile males. In the Northern Hemisphere, mature females ovulate April through August. During this season one or more large mature bulls temporarily join each breeding school. A single calf is born after a 15-month gestation. A mature female will produce a calf every 4-6 years. Females attain sexual maturity at a mean age of nine years, while males have a prolonged puberty and attain sexual maturity at about age 20 (Waring *et al.* 2002). Bachelor schools consist of maturing males who leave the breeding school and aggregate in loose groups of about 40 animals. As the males grow older they separate from the bachelor schools and remain solitary most of the year (Best 1979). Male sperm whales may not reach physical maturity until they are 45 years old (Waring *et al.* 2002). The sperm whales prey consists of larger mesopelagic squid (e.g., *Architeuthis* and *Moroteuthis*) and fish species (Perry *et al.* 1999). Sperm whales, especially mature males in higher latitude waters, have been observed to take significant quantities of large demersal and mesopelagic sharks, skates, and bony fishes (Clarke 1962, 1980).

Few instances of injury or mortality of sperm whales due to human impacts have been recorded in U.S. waters. Because of their generally more offshore distribution and their benthic feeding habits, sperm whales are less subject to entanglement than are right or humpback whales. Documented takes primarily involve offshore fisheries such as the offshore lobster pot fishery and pelagic driftnet and pelagic longline fisheries. The NMFS Sea Sampling program recorded three entanglements (in 1989, 1990, and 1995) of sperm whales in the swordfish drift gillnet fishery prior to permanent closure of the fishery in January 1999. All three animals were injured, found alive, and released. However, at least one was still carrying gear. Opportunistic reports of sperm whale entanglements for the years 1993-1997 include three records involving offshore lobster pot gear, heavy monofilament line, and fine mesh gillnet from an unknown source. Sperm whales may also interact opportunistically with fishing gear. Observers aboard Alaska sablefish and Pacific halibut longline vessels have documented sperm whales feeding on longline caught fish in the Gulf of Alaska (Perry *et al.* 1999). Behavior similar to that observed in the Alaskan longline fishery has also been documented during longline operations off South America where sperm whales have become entangled in longline gear, have been observed feeding on fish caught in the gear, and have been reported following longline vessels for days (Perry *et al.* 1999).

Sperm whales are also struck by ships. In May 1994 a ship struck sperm whale was observed south of Nova Scotia (Waring *et al.* 2002). A sperm whale was also seriously injured as a result of a ship strike in May 2000 in the western Atlantic. Due to the offshore distribution of this species, interactions that do occur are less likely to be reported than those involving right, humpback, and fin whales that more often occur in nearshore areas. Other impacts noted above for baleen whales may also occur.

Due to their offshore distribution, sperm whales tend to strand less often than, for example, right whales and humpbacks. Preliminary data for 2000 indicate that of ten sperm whales reported to the stranding network (nine dead and one injured) there was one possible fishery interaction, one ship strike (wounded with bleeding gash on side) and eight animals for which no signs of entanglement or injury were sighted or reported. No sperm whales have stranded or been reported to the stranding network as of February 2001.

**Loggerhead Sea Turtle**

The loggerhead turtle was listed as "threatened" under the ESA on July 28, 1978, but is considered endangered by the World Conservation Union (IUCN) and under the Convention on International Trade in Endangered Species of Flora and Fauna (CITES). Loggerhead sea turtles are found in a wide range of habitats throughout the temperate and tropical regions of the Atlantic. These include open ocean, continental shelves, bays, lagoons, and estuaries (NMFS& FWS 1995). In the management unit of this FMP they are most common on the open ocean in the northern Gulf of Maine, particularly where associated with warmer water fronts formed from the Gulf Stream. The species is also found in entrances to bays and sounds and within bays and estuaries, particularly in the Mid-Atlantic.

Since they are limited by water temperatures, sea turtles do not usually appear on the summer foraging grounds in the Gulf of Maine until June, but are found in Virginia as early as April. They remain in these areas until as late as November and December in some cases, but the large majority leave the Gulf of Maine by mid-September. Loggerheads are primarily benthic feeders, opportunistically foraging on crustaceans and mollusks (NMFS & FWS 1995). Under certain conditions they also feed on finfish, particularly if they are easy to catch *(e.g.,* caught in gillnets or inside pound nets where the fish are accessible to turtles).

A Turtle Expert Working Group (TEWG 2000), conducting an assessment of the status of the loggerhead sea turtle population in the Western North Atlantic (WNA), concluded that there are at least four loggerhead subpopulations separated at the nesting beach in the WNA (TEWG 1998). However, the group concluded that additional research is necessary to fully address the stock definition question. The four nesting subpopulations include the following areas: northern North Carolina to northeast Florida, south Florida, the Florida Panhandle, and the Yucatan Peninsula. Genetic evidence indicates that loggerheads from Chesapeake Bay southward to Georgia appear nearly equally divided in origin between South Florida and northern subpopulations. Additional research is needed to determine the origin of turtles found north of the Chesapeake Bay.

The TEWG (1998) analysis also indicated the northern subpopulation of loggerheads may be experiencing a significant decline (2.5% - 3.2% for various beaches). A recovery goal of 12,800 nests has been assumed for the Northern Subpopulation, but TEWG (1998) reported nest number at around 6,200 (TEWG 1998). More recently, the addition of nesting data from the years 1996, 1997 and 1998, did not change the assessment of the TEWG that the number of loggerhead nests in the Northern Subpopulation is stable or declining (TEWG 2000). Since the number of nests have declined in the 1980's, the TEWG concluded that it is unlikely that this subpopulation will reach this goal given this apparent decline and the lack of information on the subpopulation from which loggerheads in the WNA originate. Continued efforts to reduce the adverse effects of fishing and other human-induced mortality on this population are necessary.

The most recent 5-year ESA sea turtle status review (NMFS & USFWS 1995) highlights the difficulty of assessing sea turtle population sizes and trends. Most long-term data comes from nesting beaches, many of which occur extensively in areas outside U.S. waters. Because of this lack of information, the TEWG was unable to determine acceptable levels of mortality. This status review supports the conclusion of the TEWG that the northern subpopulation may be experiencing a decline and that inadequate information is available to assess whether its status has changed since the initial listing as threatened in 1978. NMFS & USFWS (1995) concluded that loggerhead turtles should remain designated threatened but noted that additional research will be necessary before the next status review can be conducted.

**Leatherback Sea Turtle**

Leatherback turtles are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic, Pacific, Caribbean, and the Gulf of Mexico (Ernst and Barbour 1972). The leatherback sea turtle is the largest living turtle and ranges farther than any other sea turtle species, exhibiting broad thermal tolerances (NMFS and USFWS, 1995). Evidence from tag returns and strandings in the western Atlantic suggests that adults engage in routine migrations between boreal, temperate and tropical waters (NMFS and USFWS, 1992). In the U.S., leatherback turtles are found throughout the action area of this consultation. Located in the northeastern waters during the warmer months, this species is found in coastal waters of the continental shelf and near the Gulf Stream edge, but rarely in the inshore areas. However, leatherbacks may migrate close to shore, as a leatherback was satellite tracked along the mid-Atlantic coast, thought to be foraging in these waters. A 1979 aerial survey of the outer Continental Shelf from Cape Hatteras, North Carolina to Cape Sable, Nova Scotia showed leatherbacks to be present throughout the area with the most numerous sightings made from the Gulf of Maine south to Long Island. Shoop and Kenney (1992) also observed concentrations of leatherbacks during the summer off the south shore of Long Island and off New Jersey. Leatherbacks in these waters are thought to be following their preferred jellyfish prey. This aerial survey estimated the leatherback population for the northeastern U.S. at approximately 300-600 animals (from near Nova Scotia, Canada to Cape Hatteras, North Carolina).

Compared to the current knowledge regarding loggerhead populations, the genetic distinctness of leatherback populations is less clear. However, genetic analyses of leatherbacks to date indicate female turtles nesting in St. Croix/Puerto Rico and those nesting in Trinidad differ from each other and from turtles nesting in Florida, French Guiana/Suriname and along the South African Indian Ocean coast. Much of the genetic diversity is contained in the relatively small insular subpopulations. Although populations or subpopulations of leatherback sea turtles have not been formally recognized, based on the most recent reviews of the analysis of population trends of leatherback sea turtles, and due to our limited understanding of the genetic structure of the entire species, the most conservative approach would be to treat leatherback nesting populations as distinct populations whose survival and recovery is critical to the survival and recovery of the species. Further, any action that appreciably reduced the likelihood for one or more of these nesting populations to survive and recover in the wild, would appreciably reduce the species' likelihood of survival and recovery in the wild.

Leatherbacks are predominantly a pelagic species and feed on jellyfish (i.e., *Stomolophus, Chryaora*, and *Aurelia* (Rebel 1974)), cnidarians (medusae, siphonophores) and tunicates (salps, pyrosomas). Time-Depth-Recorder data recorded by Eckert *et al.* (1998b) indicate that leatherbacks are night feeders and are deep divers, with recorded dives to depths in excess of 1000 meters. However, leatherbacks may come into shallow waters if there is an abundance of jellyfish nearshore. Leary (1957) reported a large group of up to 100 leatherbacks just offshore of Port Aransas, Texas associated with a dense aggregation of Stomolophus. Leatherbacks also occur annually in places such as Cape Cod and Narragansett Bays during certain times of the year, particularly the fall.

Although leatherbacks are a long lived species (> 30 years), they are somewhat faster to mature than loggerheads, with an estimated age at sexual maturity reported as about 13-14 years for females, and an estimated minimum age at sexual maturity of 5-6 years, with 9 years reported as a likely minimum (Zug and Parham 1996) and 19 years as a likely maximum (NMFS 2001). In the U.S. and Caribbean, female leatherbacks nest from March through July. They nest frequently (up to 7 nests per year) during a nesting season and nest about every 2-3 years. During each nesting, they produce 100 eggs or more in each clutch and thus, can produce 700 eggs or more per nesting season (Schultz 1975). The eggs will incubate for 55-75 days before hatching. The habitat requirements for post-hatchling leatherbacks are virtually unknown (NMFS and USFWS 1992).

Anthropogenic impacts to the leatherback population are similar to those discussed above for the loggerhead sea turtle, including fishery interactions as well as intense exploitation of the eggs (Ross 1979). Eckert (1996) and Spotila *et al.* (1996) record that adult mortality has also increased significantly, particularly as a result of driftnet and longline fisheries. Zug and Parham (1996) attribute the sharp decline in leatherback populations to the combination of the loss of long-lived adults in fishery related mortality, and the lack of recruitment stemming from elimination of annual influxes of hatchlings because of intense egg harvesting.

Poaching is not known to be a problem for U.S. nesting populations. However, numerous fisheries that occur in both U.S. state and Federal waters are known to negatively impact juvenile and adult leatherback sea turtles. These include incidental take in several commercial and recreational fisheries. Fisheries known or suspected to incidentally capture leatherbacks include those deploying bottom trawls, off-bottom trawls, purse seines, bottom longlines, hook and line, gill nets, drift nets, traps, haul seines, pound nets, beach seines, and surface longlines (NMFS and USFWS 1992). At a workshop held in the Northeast in 1998 to develop a management plan for leatherbacks, experts expressed the opinion that incidental takes in fisheries were likely higher than is being reported.

Leatherback interactions with the southeast shrimp fishery are also common. Turtle Excluder Devices (TEDs), typically used in the southeast shrimp fishery to minimize sea turtle/fishery interactions, are less effective for the large-sized leatherbacks. Therefore, the NMFS has used several alternative measures to protect leatherback sea turtles from lethal interactions with the shrimp fishery. These include establishment of a Leatherback Conservation Zone (60 FR 25260). NMFS established the zone to restrict, when necessary, shrimp trawl activities from off the coast of Cape Canaveral, Florida to the Virginia/North Carolina Border. It allows the NMFS to quickly close the area or portions of the area to the shrimp fleet on a short-term basis when high concentrations of normally pelagic leatherbacks are recorded in more coastal waters where the shrimp fleet operates. Other emergency measures may also be used to minimize the interactions between leatherbacks and the shrimp fishery. For example, in November 1999 parts of Florida experienced an unusually high number of leatherback strandings. In response, the NMFS required shrimp vessels operating in a specified area to use TEDs with a larger opening for a 30-day period beginning December 8, 1999 (64 FR 69416) so that leatherback sea turtles could escape if caught in the gear.

Leatherbacks are also susceptible to entanglement in lobster and crab gear, possibly as a result of attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, attraction to the buoys which could appear as prey, or the gear configuration which may be more likely to wrap around flippers. The total number of leatherbacks reported entangled from New York through Maine from all sources for the years 1980 - 2000 is 119; out of this total, 92 of these records occurred from1990-2000. Entanglements are also common in Canadian waters where Goff and Lien (1988) reported that 14 of 20 leatherbacks encountered off the coast of Newfoundland/Labrador were entangled in fishing gear including salmon net, herring net, gillnet, trawl line and crab pot line. It is unclear how leatherbacks become entangled in such gear. Prescott (1988) reviewed stranding data for Cape Cod Bay and concluded that for those turtles where cause of death could be determined (the minority), entanglement in fishing gear is the leading cause of death followed by capture by dragger, cold stunning, or collision with boats.

Spotila *et al.* (1996) describe a hypothetical life table model based on estimated ages of sexual maturity at both ends of the species' natural range (5 and 15 years). The model concluded that leatherbacks maturing in 5 years would exhibit much greater population fluctuations in response to external factors than would turtles that mature in 15 years. Furthermore, the simulations indicated that leatherbacks could maintain a stable population only if both juvenile and adult survivorship remained high, and that if other life history stages (i.e., egg, hatchling, and juvenile) remained static. Model simulations indicated that an increase in adult mortality of more than 1% above background levels in a stable population was unsustainable. As noted, there are many human-related sources of mortality to leatherbacks; a tally of all leatherback takes anticipated annually under current biological opinions completed for the NMFS June 30, 2000, biological opinion on the pelagic longline fishery projected a potential for up to 801 leatherback takes, although this sum includes many takes expected to be nonlethal. Leatherbacks have a number of pressures on their populations, including injury or mortality in fisheries, other Federal activities (e.g., military activities, oil and gas development, etc.), degradation of nesting habitats, direct harvest of eggs, juvenile and adult turtles, the effects of ocean pollutants and debris, lethal collisions, and natural disturbances such as hurricanes (which may wipe out nesting beaches).

Spotila *et al.* (1996) recommended not only reducing mortalities resulting from fishery interactions, but also advocated protection of eggs during the incubation period and of hatchlings during their first day, and indicated that such practices could potentially double the chance for survival and help counteract population effects resulting from adult mortality. They conclude, "stable leatherback populations could not withstand an increase in adult mortality above natural background levels without decreasing . . . the Atlantic population is the most robust, but it is being exploited at a rate that cannot be sustained and if this rate of mortality continues, these populations will also decline. "

Estimated to number approximately 115,000 adult females globally in 1980 (Pritchard 1982) and only 34,500 by 1995 (Spotila *et al.* 1996), leatherback populations have been decimated worldwide, not only by fishery related mortality but, at least historically, primarily due to intense exploitation of the eggs (Ross 1979). On some beaches nearly 100% of the eggs laid have been harvested (Eckert 1996). Eckert (1996) and Spotila *et al.* (1996) record that adult mortality has also increased significantly, particularly as a result of driftnet and longline fisheries. Spotila (2000) states that a conservative estimate of annual leatherback fishery-related mortality (from longlines, trawls and gillnets) in the Pacific during the 1990s is 1,500 animals. He estimates that this represented about a 23% mortality rate (or 33% if most mortality was focused on the East Pacific population).

Nest counts are currently the only reliable indicator of population status available for leatherback turtles. The status of the leatherback population in the Atlantic is difficult to assess since major nesting beaches occur over broad areas within tropical waters outside the United States. Recent information suggests that Western Atlantic populations declined from 18,800 nesting females in 1996 (Spotila *et al.* 1996) to 15,000 nesting females by 2000. Eastern Atlantic (i.e., off Africa, numbering ~ 4,700) and Caribbean (4,000) populations appear to be stable, but there is conflicting information for some sites and it is certain that some populations (e.g., St. John and St. Thomas, U.S. Virgin Islands) have been extirpated (NMFS and USFWS 1995). It does appear, however, that the Western Atlantic population is being subjected to mortality beyond sustainable levels, resulting in a continued decline in numbers of nesting females.

**Kemp's Ridley Sea Turtle**

The Kemp's ridley is probably the most endangered of the world's sea turtle species. The only major nesting site for ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963). Estimates of the adult population reached a low of 1,050 in 1985, but increased to 3,000 individuals in 1997. First-time nesting adults have increased from 6% to 28% from 1981 to 1989, and from 23% to 41% from 1990 to 1994, indicating that the ridley population may be in the early stages of growth (TEWG 1998). More recently the TEWG (2000) concluded that the Kemp's Ridley population appears to be in the early stages of exponential expansion. While the number of females nesting annually is estimated to be orders of magnitude less than historical levels, the mean rate of increase in the annual number of nests has accelerated over the period 1987-1999. Preliminary analyses suggest that the intermediate recovery goal of 10,000 nesting females by 2020 may be achievable (TEWG 2000).

Juvenile Kemp's ridleys inhabit northeastern US coastal waters where they forage and grow in shallow coastal during the summer months. Juvenile ridleys migrate southward with autumnal cooling and are found predominantly in shallow coastal embayments along the Gulf Coast during the late fall and winter months.

Ridleys found in mid-Atlantic waters are primarily post-pelagic juveniles averaging 40 cm in carapace length, and weighing less than 20 kg. After loggerheads, they are the second most abundant sea turtle in Virginia and Maryland waters, arriving in there during May and June and then emigrating to more southerly waters from September to November. In the Chesapeake Bay, ridleys frequently forage in shallow embayments, particularly in areas supporting submerged aquatic vegetation (Lutcavage and Musick 1985). The juvenile population in Chesapeake Bay is estimated to be 211 to 1,083 turtles.

The model presented by Crouse *et al.* (1987) illustrates the importance of subadults to the stability of loggerhead populations and may have important implications for Kemp's ridleys. The vast majority of ridleys identified along the Atlantic Coast have been juveniles and subadults. Sources of mortality in this area include incidental takes in fishing gear, pollution and marine habitat degradation, and other man-induced and natural causes. Loss of individuals in the Atlantic, therefore, may impede recovery of the Kemp's ridley sea turtle population. Sea sampling data from the northeast otter trawl fishery and southeast shrimp and summer flounder bottom trawl fisheries has recorded takes of Kemp's ridley turtles.

**Green Sea Turtle**

Green sea turtles are more tropical in distribution than loggerheads, and are generally found in waters between the northern and southern 20°C isotherms. In the wester Atlantic region, the summer developmental habitat encompasses estuarine and coastal waters as far north as Long Island Sound, Chesapeake Bay, and the North Carolina sounds, and south throughout the tropics (NMFS 1998). Most of the individuals reported in U.S. waters are immature (NMFS 1998). Green sea turtles found north of Florida during the summer must return to southern waters in autumn or risk the adverse effects of cold temperatures.

There is evidence that green turtle nesting has been on the increase during the past decade. For example, increased nesting has been observed along the Atlantic coast of Florida on beaches where only loggerhead nesting was observed in the past (NMFS 1998). Recent population estimates for the western Atlantic area are not available. Green turtles are threatened by incidental captures in fisheries, pollution and marine habitat degradation, destruction/disturbance of nesting beaches, and other sources of man-induced and natural mortality.

Juvenile green sea turtles occupy pelagic habitats after leaving the nesting beach. At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats, and enter benthic foraging areas, shifting to a chiefly herbivorous diet (NMFS 1998). Post-pelagic green turtles feed primarily on sea grasses and benthic algae, but also consume jellyfish, salps, and sponges. Known feeding habitats along U.S. coasts of the western Atlantic include shallow lagoons and embayments in Florida, and similar shallow inshore areas elsewhere (NMFS 1998).

Sea sampling data from the scallop dredge fishery and southeast shrimp and summer flounder bottom trawl fisheries have recorded incidental takes of green turtles

**Shortnose Sturgeon**

Shortnose sturgeon occur in large rivers along the western Atlantic coast from the St. Johns River, Florida (possibly extirpated from this system), to the Saint John River in New Brunswick, Canada. The species is anadromous in the southern portion of its range *(i.e.,* south of Chesapeake Bay), while northern populations are amphidromous (NMFS 1998). Population sizes vary across the species' range with the smallest populations occurring in the Cape Fear and Merrimack Rivers and the largest populations in the Saint John and Hudson Rivers (Dadswell 1979; NMFS 1998).

Shortnose sturgeon are benthic and mainly inhabit the deep channel sections of large rivers. They feed on a variety of benthic and epibenthic invertebrates including molluscs, crustaceans (arnphipods, chironomids, isopods), and oligochaete worms (Vladykov and Greeley 1963; Dadswell 1979). Shortnose sturgeon are long-lived (30 years) and mature at relatively old ages. In northern areas, males reach maturity at 5-10 years, while females reach sexual maturity between 7 and 13 years.

In the northern part of their range, shortnose sturgeon exhibit three distinct movement patterns that are associated with spawning, feeding, and overwintering periods. In spring, as water temperatures rise above 8° C, pre-spawning shortnose sturgeon move from overwintering grounds to spawning areas. Spawning occurs from mid/late April to mid/late May. Post-spawned sturgeon migrate downstream to feed throughout the summer.

As water temperatures decline below 8° C again in the fall, shortnose sturgeon move to overwintering concentration areas and exhibit little movement until water temperatures rise again in spring (NMFS 1998). Young-of-the-year shortnose sturgeon are believed to move downstream after hatching (NMFS 1998) but remain within freshwater habitats. Older juveniles tend to move downstream in fall and winter as water temperatures decline and the salt wedge recedes. Juveniles move upstream in spring and feed mostly in freshwater reaches during summer.

Shortnose sturgeon spawn in freshwater sections of rivers, typically below the first impassable barrier on the river *(e.g.,* dam). Spawning occurs over channel habitats containing gravel, rubble, or rock-cobble substrates (NMFS 1998). Environmental conditions associated with spawning activity include decreasing river discharge following the peak spring freshet, water temperatures ranging from 9 -12 C, and bottom water velocities of 0.4 - 0.7 m/sec (NMFS 1998).

**Atlantic salmon**

The recent ESA-listing for Atlantic salmon covers the wild population of Atlantic salmon found in rivers and streams from the lower Kennebec River north to the U.S.-Canada border. These include the Dennys, East Machias, Machias, Pleasant, Narraguagus, Ducktrap, and Sheepscot Rivers and Cove Brook. Atlantic salmon are an anadromous species with spawning and juvenile rearing occurring in freshwater rivers followed by migration to the marine environment. Juvenile salmon in New England rivers typically migrate to sea in May after a two to three year period of development in freshwater streams, and remain at sea for two winters before returning to their U.S. natal rivers to spawn from mid October through early November. While at sea, salmon generally undergo an extensive northward migration to waters off Canada and Greenland. Data from past commercial harvest indicate that post-smolts overwinter in the southern Labrador Sea and in the Bay of Fundy. The numbers of returning wild Atlantic salmon within the Gulf of Maine Distinct Population Segment (DPS) are perilously small with total run sizes of approximately 150 spawners occurring in 1999 (Baum 2000). Although capture of Atlantic salmon has occurred in commercial fisheries (usually otter trawl or gillnet gear) or by research/survey, no salmon have been reported captured in the Atlantic surfclam and ocean quahog fisheries.

**Seabirds**

Most of the following information about seabirds is taken from the Mid-Atlantic Regional Marine Research Program (1994) and Peterson (1963). Fulmars occur as far south as Virginia in late winter and early spring. Shearwaters, storm petrels (both Leach's and Wilson's), jaegers, skuas, and some terns pass through this region in their annual migrations. Gannets and phalaropes occur in the Mid-Atlantic during winter months. Nine species of gulls breed in eastern North America and occur in shelf waters off the northeastern US. 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.). In addition, the bald eagle is listed as threatened under the ESA and is a bird of aquatic ecosystems.

Like marine mammals, seabirds are vulnerable to entanglement in commercial fishing gear. Human activities such as coastal development, habitat degradation, and the presence of organochlorine contaminants are considered the major threats to some seabird populations.

### 4.3 Port and Community Description

For Amendment 13 (MAFMC 2003c) to this FMP, the Council hired Dr. Bonnie McCay and her associates at Rutgers University to describe the ports and communities that are associated with the surfclam and ocean quahog fisheries. The researchers did an extensive job of characterizing the three main fisheries. Amendment 13 (MAFMC 2003c) details all of the fisheries and the quota recommendation paper (MAFMC 2003a) details the Maine ocean quahog fishery.

Communities from Maine to Virginia are involved in the harvesting and processing of surfclams and ocean quahogs. Ports in New Jersey and Massachusetts handle the most volume and value, particularly Atlantic City, Point Pleasant, New Bedford, and Cape May/Wildwood. There are also significant landings in Ocean City, Maryland, Warren, Rhode Island, and the Jonesport and Beals Island area of Maine. The Maine fishery is entirely for ocean quahogs, which are sold as shellstock for the half-shell market. The other fisheries are industrialized ones for surfclams and ocean quahogs, which are hand shucked or steam-shucked and processed into fried, canned, and frozen products. Processing plants are therefore major components of the fishery, and the communities in which they are found must be described as well as the port towns. Some of them meet the definition of "fishing community" found in the Sustainable Fisheries Act of 1996: "[t]he term "fishing community" means a community which is substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs, and includes fishing vessel owners, operators, and crew and United States fish processors that are based in such community." The McCay team characterizations of the ports and communities are based on government census and labor statistics and on observations and interviews carried out during the late 1990s and in the fall of 2001.

### 4.4 Federal Fleet Profile

The total number of vessels participating in the surfclam and ocean quahog fishery outside the State of Maine increased by 3 vessels in 2002. Of importance in recent years was the loss of four vessels in weather-related accidents in January of 1999. By the end of 2002, four vessels of new construction had commenced fishing operations to fill the gap.

| Federal Fleet Profile | | | | | | | |
|---|---|---|---|---|---|---|---|
| Non-Maine Vessels | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
| Harvests BOTH surfclams & ocean quahogs | 14 | 14 | 8 | 11 | 12 | 14 | 16 |
| Harvests only surfclams | 20 | 19 | 23 | 22 | 19 | 21 | 23 |
| Harvests only ocean quahogs | 22 | 17 | 16 | 12 | 17 | 16 | 15 |
| Total Non-Maine Vessels | 56 | 50 | 47 | 45 | 48 | 51 | 54 |
| | | | | | | | |
| Maine Ocean Quahog Vessels | 25 | 34 | 39 | 38 | 34 | 31 | 35 |
| Source: NMFS Clam Vessel Logbooks | | | | | | | |

The major fleet shift which was apparent over time was the reduction in numbers of vessels participating in the fishery for ocean quahogs. While the total number of vessels in the Federal surfclam and ocean quahog fleet declined 20% from 1996 to 1999 (from 56 to 45 vessels), that portion which participated in the harvest of ocean quahogs dropped by more than one-third over the same interval (from 36 to 23 vessels).

As discussed in earlier sections, this trend reversed slightly in 2000 as 6 additional vessels made trips for ocean quahogs outside the State of Maine. In 2001 it reversed further with the net addition of one more vessel, and is continuing as new vessels have made their way out of construction yards in 2002. On the horizon is the planned operation of a vessel capable of processing its harvest at sea.

### 4.4.1. Fleet Age

At the end of 2002, the average age of a vessel participating in the Federal surfclam fishery was 25.9 years.

Newest = Lady Brittany (less than 1 year old - built 2002)
Oldest = Lisa Kim (37 years old - built 1966)

Of those vessels participating in the Federal ocean quahog fishery, the average age was 24.5 years.

Newest = Big Bob and Lady Brittany (each less than 1 year old - built 2002)
Oldest = Wando River (46 years old - built 1957)

## 4.5 Processing Sector

As of mid-2003 there were a total of 9 companies which were reported as having made purchases of surfclams or ocean quahogs outside the State of Maine. Dealer reports are required of all entities receiving Federal harvests of these two species managed under the ITQ system.

The largest processor is Sea Watch International, with plants in Milford, Delaware and New Bedford, Massachusetts. Listed from north to south, the processors are arrayed as follows:

- Massachusetts
    - Fair Tide Shellfish LTD.
    - Sea Watch International, New Bedford Plant
- Rhode Island
    - Blount Seafood Corp.
    - Galilean Seafood Inc.
- New Jersey
    - Cape May Foods (prior name "Cape May Canners, Inc.")
    - Point Pleasant Packing, Inc.
    - Surfside Products Inc.
- Delaware
    - Sea Watch International, Milford Plant
- Virginia
    - Eastern Shore Seafood Products
    - J H Miles & Company Inc.

There has been an increasing trend toward vertical integration, where companies own both vessels and processing facilities. An example is the merger of Sea Watch International and the Truex fleet of vessels in the summer of 1999.

There were a total of 10 entities in the State of Maine to whom vessels reported selling ocean quahogs as of mid-2003:

1. A C Inc.
2. Al's Seafood
3. Atlantic Shellfish
4. Beals Lobster Co., Inc.
5. CNW Seafood
6. D C Air & Seafood Inc.
7. Kip's Seafood Co.
8. Maine's Best Seafood, Inc.
9. Moosabec Mussels, Inc.
10. Old Salt Seafood

## 5.0 DESCRIPTION OF THE RESOURCES AND THE FISHERIES

### 5.1 Surfclam *Spisula solidissima*

#### 5.1.1 Status of the Stock

Surfclams are bivalve mollusks which are distributed in the western North Atlantic from the southern Gulf of St. Lawrence to Cape Hatteras. Commercial fisheries have generally concentrated on the populations of surfclams which have flourished in the sandy ocean sediments off the coast of New Jersey and the Delmarva peninsula. Growth rates are relatively rapid, with clams reaching preferable/harvestable size (approximately 5 inches) in about six years. Maximum size is about 9 inches in length, though individuals larger than 8 inches are rare. They have a longevity of approximately 35 years, and while some individuals reach sexual maturity within three months, most spawn by the end of their second year.

**Note**: the following "State of the Stock," “Management Advice," and “Forecast” sections are taken directly from the SARC advisory report (March 2000), and therefore are expressed in metric units (1 kg = 2.205 lbs, there are 17 lbs/bushel for surfclams and 10 lbs/bushel for ocean quahogs). Also included here is the 2003 SARC #37 "Management Advice" and the first sentence from the "State of the Stock". The 2003 SARC was just completed and presented to the MAFMC at their August Council meeting. The Council made their recommendations on the specifications for surfclams and ocean quahogs to the Secretary at their June meeting and thus did not have the benefit of the 2003 stock assessment information. In general, the 2003 assessment confirms the status of the surfclam resource which was developed at the 2000 assessment and is presented here simply as a confirmation of that 2000 assessment.

**State of Stock:** The EEZ surfclam stock (animals in waters beyond 3 mile state limits) is at a high level of biomass and under-exploited. Surfclams in state waters were not assessed. Fishing mortality is low. Estimated mean annual fishing mortality rates (F) from 1997-1999 were 0.02 for the entire EEZ resource, 0.03 – 0.04 for the northern New Jersey (NNJ) region, and 0.04 -

0.07 for the southern New Jersey (SNJ) region. The majority of the catch is derived from NNJ, which contains about 39% of the stock biomass. Recent Fs are less than the current overfishing definition ($F_{20\%}$ = 0.18, estimated in the previous assessment assuming M=0.05) or a new overfishing definition recommended by the SARC (an $F_{MSY}$ proxy of F=M=0.15).

From the 2003 SARC – **State of Stock:** The surfclam stock in the EEZ is not overfished and overfishing is not occurring.

**Management Advice:** Fishing mortality can be increased for the surfclam resource taken as a whole. However, it may be advantageous to avoid localized depletion.

From the 2003 SARC -- **Management Advice:** Although the stock is above Bmsy, uncertainty in the current level and future trend in biomass suggest that substantial increases in catch levels are not advised. In addition, because surfclams are sedentary and fishing is concentrated in relatively small areas, it may be advantageous to avoid localized depletion.

**Forecasts:** Short term deterministic projections for 1999-2002 were performed using recent catch (average 1997-1999) with 20% non-catch mortality from fishing, recent recruitment levels (average 1997-1999) and assuming M=0.15 $y^{-1}$. Projections suggest little change (4%) in total clam biomass during 1999-2002, although larger changes in some regions are possible.

| Stock Assessment Region[1,2] | Biomass 1999 | CV | Recent Mean Catch+ 20% | Recent Mean Recruitment | Biomass 2002 | % Change in Biomass |
|---|---|---|---|---|---|---|
| SVA | 2,500 | 71% | 2 | 0 | 1,600 | -36% |
| DMV | 320,000 | 52% | 900 | 23,000 | 331,000 | 3% |
| SNJ | 68,000 | 114% | 4,000 | 12,000 | 81,000 | 19% |
| NNJ | 480,000 | 26% | 16,000 | 42,000 | 441,000 | -8% |
| LI | 47,000 | 72% | 100 | 3,000 | 48,000 | 1% |
| SNE | 84,000 | 40% | 90 | 4,900 | 82,000 | -3% |
| GBK | 265,000 | 34% | 0 | 29,000 | 334,000 | 26% |
| Total | 1,268,000 | 19% | 21,000 | 114,000 | 1,319,000 | 4% |

[1] SVA = southern Virginia, DMV = Delmarva, NNJ = Northern New Jersey, SNJ= Southern New Jersey, LI = Long Island, SNE = southern New England, GBK = Georges Bank
[2] Source: KLAMZ assessment model, USDC 2000a.

### 5.1.2 Fisheries

| Surfclam Landings: Both State and Federal Waters | | | | | |
|---|---|---|---|---|---|
| Region | 2001 | | | 2002 | |
| | Bushels | Value* | | Bushels | Value* |
| New England States | 31,699 | $470,049 | | 189,467 | $694,455 |
| Mid-Atlantic States | 4,018,930 | $39,085,194 | | 4,191,526 | 40,676,599 |
| Total | 4,050,629 | $39,555,243 | | 4,380,993 | 41,371,054 |

Source: NMFS Unpublished Landings Data, Woods Hole, MA
*Values are preliminary estimates. Actual values will be higher.

Coastwide landings of surfclams totaled approximately 4.38 million bushels (bu) in 2002, an increase of 8.2% from the 4.05 million bushels landed in 2001.

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. In 2002, all of the quotas were fully harvested from all of the jurisdictions.

For the first time in 2002, trace amounts of surfclams were harvested from the state waters of Maine.

**The New Jersey Inshore Fishery for Surfclams**

New Jersey manages the largest state fishery for surfclams. They conduct a survey every summer and produce a resource report every three years. According to their *Inventory of New Jersey surfclam (Spisula solidissima) resource* report (NJ Fish and Wildlife 2000), the total surfclam standing stock for New Jersey territorial waters from Shark River Inlet to Cape May in 1999 was 24 million bushels. Annually, the state surveys about 330 stations. The biomass of inshore New Jersey has fallen precipitously. From the high in 1999, the biomass dropped to 15.6 million bushels in 2000, to 12 million bushels in 2001, and declined in half by 2002. The overall length-frequency distributions have not changed dramatically, but the mean shell lengths have been steadily increasing since 1993. The mean shell length of surfclams found in 1993 was 3.9 inches and has steadily increased to a mean shell length of 4.8 inches. The most notable difference recently has been the lack of clams collected that measured less than 2.7 inches in the last several years. During the past three surveys (2000, 2001, and 2002), there have been less than 100 total clams collected that were less than the 2.7 inches, whereas during the 1990s there were thousands of small clams collected in each individual survey (Normant pers. comm.). The majority of the resource is harvested from the territorial sea adjacent to the Federal northern NJ assessment region, however in recent years the harvest from areas adjacent to the Federal southern NJ region have increased dramatically for the first time since the early 1970s.

A constant annual quota of 600,000 bushels had been maintained for years until the 1999/2000 season, when the quota was increased to 700,000 bushels. With the lack of recent recruitment, the state lowered the quota back to 600,000 bushels for 2002/2003. New Jersey establishes the quota between 250,000 and a million bushels with a constraint that the quota can not exceed 10% of the estimated standing stock. For 2002/2003 the quota was set at the 600,000 bushel level which was approximately 10% of the standing stock. New Jersey is unique in defining a season which begins in October of one calendar year and closes at the end of May in the next.

| New Jersey Surfclam Fishery | | | | |
|---|---|---|---|---|
| Season (Oct - May) | Quota (bu) | Landings (bu) | Bushels Unharvested | Percent Unharvested |
| FY 95/96 | 600,000 | 566,120 | 33,880 | 6% |
| FY 96/97 | 600,000 | 468,377 | 131,623 | 22% |
| FY 97/98 | 600,000 | 467,569 | 132,431 | 22% |
| FY 98/99 | 600,000 | 570,852 | 29,148 | 5% |
| FY 99/00 | 700,000 | 699,649 | 351 | .05% |
| FY 00/01 | 700.000 | 700,256 | (256) | (0.04%) |
| FY 01/02 | 700,000 | 702,257 | (2,257) | (0.3%) |
| FY 02/03* | 600,000 | 592,032 | | |

* Landings for 2003 not final, all quota likely will be taken.

Source: New Jersey Division of Fish and Wildlife

Many vessels in the New Jersey inshore fishery for surfclams also participate in the Federal fishery. For the recently completed fishing year (2002/2003), it is likely that none of the quota will be left unharvested. The past five fishing years represent a significant improvement relative to the prior two seasons, which saw fully 22% of the quota unharvested each year. Fortunately, vessels experienced virtually no problems in selling their catches in the recently completed fishing year. There are 57 licenses for inshore New Jersey. Up to three licenses can be combined onto one vessel. Each license receives an equal share of the annual quota and those fishermen can fish their quota whenever it is appropriate. There is no race to catch these shellfish.

## The New York Inshore Fishery for Surfclams

New York inshore waters are divided into two segments: Long Island Sound and Atlantic Ocean waters out to three miles. While there are approximately 100 permits for the Long Island Sound area, the quantity of surfclams landed from that area is small, with landings less than 500 bushels annually in years prior to 2002. Landings greatly increased in 2002 and the 50,000 bushel quota was approached. In 2003, there have already been over 56,000 bushels landed and this fishery has been closed for the year.

The vast majority of New York state waters' harvest is from the Atlantic Ocean area, for which there are currently 23 moratorium vessel permits, held by 17 owners (Davidson pers. comm.). When a moratorium and quota management were instituted in 1994, there were a total of 25 moratorium vessel permits issued. Two of these permits were canceled for failing to meet the minimum harvest requirement of 5,000 bushels per year. (This requirement has since been repealed.)

| 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 | 227,000 | 55% under |
| 1999 | 500,000 | 266,795 | 47% under |
| 2000 | 500,000 | 339,142 | 32% under |
| 2001 | 500,000 | 443,859 | 11% under |
| 2002 | 500,000 | 501,290 | 0.3% over |
| 2003 | 5000,000 | 139,734 (through March) | 12% of quarterly quota |
| Source: NY Dept. of Environmental Conservation | | | |

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

Harvests peaked in 1993 at just over 850,000 bushels, trended downward through 1998, and have since been increasing steadily. As the market for surfclams began shrinking in the mid 1990s, the black, lower-yielding resource off New York's Atlantic coast most strongly felt the effects. This is currently not the case as the quota was slightly exceeded in 2002 and demand is very strong so far in 2003.

The New York State Department of Environmental Conservation (DEC) staffer who heads their surfclam program is Maureen Davidson. In a May 2003 contact she emphasized that landings have been increasing steadily for the past five years. Landings are no longer below the annual quota. Landings are restricted by having a weekly boat quota of 21 cages per week, but in 2002 they restricted the boats to 14 cages per week. In the first quarter of 2003, boats were allowed 21 cages initially, but as it became apparent that landings would exceed the quarterly quota, they were reduced to 14 cages per boat per week. Not all of the 23 vessels fish every week and if they did the result could be closures at the end of each quarterly period. The state is watching these quarterly landings closely as more vessels extend more effort to land the resource.

The New York surfclam survey that was completed in the summer of 1999 indicated there are "clams everywhere," an outcome which is similar to what their 1996 survey found. The 1996 estimate indicated there were 12.2 million bushels of surfclams in the 163 square mile area that is New York's Territorial Sea (Davidson pers. comm.). The 1999 survey data are still being analyzed, with the report yet to be finalized by State University of New York personnel, but preliminary estimates show a slight increase to 12.8 million bushels in the survey area. The 2002 survey was conducted by DEC personnel in cooperation with a commercial fishing vessel and no results have been released yet.

| NY Atlantic Surfclam Landings: Jan through June Comparison | | | |
|---|---|---|---|
| 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 |
| 1999 | 63,460 | 63,445 | 126,905 |
| 2000 | 75,070 | 76,980 | 152,050 |
| 2001 | 102,072 | 118,614 | 220,686 |
| 2002 | 107,392 | 135,833 | 243,225 |
| 2003 | 139,734 | no data yet available | |
| Source: NY Dept. of Environmental Conservation | | | |

A comparison of the landings for the first half of each year since 1994 indicates that landings are returning to the levels experienced in the mid-1990s after the three year drop experienced between 1998 and 2000. Davidson (pers. comm.) indicates that fishermen are currently fishing hard and having no difficulty marketing the surfclams they catch. In 2002 there were 19 vessels that fished, and the same number have fished through March in 2003.

**<u>The Federal Surfclam Fishery</u>**

The Federal fishery for surfclams was conducted by a total of 39 vessels in 2002, an increase of four vessels from the number participating in 2001 (Table 1). This number alone understates the increase in harvest capacity that has occurred in the past two years. The count of vessels in the smaller size categories actually declined by three vessels over this period. The number of vessels in the largest size category jumped from 20 vessels in 2000 to 25 in 2001 to 30 by 2002. One of these vessels is of new construction, and was launched in 2002.

For a broader perspective of how fleet capacity has changed over time, one may note that the 39 vessels operating in 2002 represent a 70% reduction from the 128 vessels reporting harvests of surfclams at the initiation of the ITQ program in 1990. The desired results of reducing overcapitalization and increasing efficiency in the fishery are readily observed by noting that the average annual catch per vessel in 1990 was 24,000 bushels, while in 2002 it was almost 80,000 bushels per vessel. To the industry as a whole, this represents an enormous savings on the costs of maintaining vessels that were simply not needed to perform the function of harvesting the annual quota in the most efficient manner possible.

Over 99% of the 3.135 million bushel quota was harvested from Federal waters in 2002, reflecting the continued strong demand for clam products following the lull that occurred in 1997 and 1998.

Exvessel prices increased again in 2002, with 62% of the vessel trip reports showing prices of $11.00 per bushel and above, compared with 33% of trips in 2001. Preliminary data from 2003 indicate that most trips have been selling in the $10.50 - $13.00 per bushel price range.

Hours of fishing effort deployed in the Federal surfclam fishery increased by a substantial 19% in 2002, augmented by the participation of 4 additional vessels. Note that this increase followed on the heels of a massive 25% increase in 2001.

A fleet-wide calculation of Landings Per Unit of Effort (LPUE) declined 8.7% to 105 bushels per hour fished in 2002 (Table 1). Stated alternatively, a 19% increase in fishing effort was used by the industry to harvest a 9% increase in the Federal surfclam quota.

The decline in surfclam LPUE would have been greater if not bolstered by the high productivity of a single, large new vessel launched in 2002.

Harvests continue to be heavily concentrated off the coast of New Jersey, with 43% of the coast-wide catch coming from the "New Jersey Nearshore" (3973) degree square (Table 4). Average LPUE of all vessels decreased 3% in this square, while the total harvest decreased 10% to 1.3 million bushels.

It is worthy of note that the second most intensively fished degree square in 2002 was not off New Jersey, but down in the southern waters off the Delmarva peninsula (3874). Both industry and fishery managers alike have been looking for an improved utilization of the denser, lower-yielding clams in this area. Harvests increased by 143% to 611,000 bushels in the square, while LPUE declined by 9%.

### 5.1.3 Economic and Social Environment

Traditionally, surfclams' dominant use has been in the "strip market" to produce fried clams. In recent years, however, they have increasingly been used in chopped or ground form for other products, such as high-quality soups and chowders.

Exvessel prices for surfclams can vary considerably depending on the quality and meat yield of surfclams from a particular area. Surfclam beds in New York state waters and off the Delmarva peninsula tend to have lower meat weights and command lower prices. Prices will also depend on the nature and terms of contracts which fishermen and allocation holders enter into with processors. The markets for surfclams and ocean quahogs have varied over time, and individual fishermen may have chosen to accept a lower price for an allocation of one species in return for assurances that the processor will purchase his allocation of the other species.

A trend evident over the past several years is one of increasing ties between the harvesting and processing sectors, which help assure each party that their needs will be met.

The reported prices in fishermen's logbooks for 2002 ranged from a low of $5.00 per bushel to a high of $18.00 per bushel for surfclams. Unfortunately, pricing data as it is currently collected is ambiguous for both surfclams and ocean quahogs. Under an individual allocation system, there are two components to the value of any particular harvest: 1) the actual cost of vessel and crew services in harvesting the catch, or "harvest services," and 2) the limited access or lease value which is created when only a limited number of individuals are granted legal access to a public resource. An ITQ system allows individuals the flexibility to harvest their annual share of the quota themselves, or to "lease" a portion or all of their harvest rights to others. Current lease prices for surfclams (as of mid-2003) are in the neighborhood of $6.25 per bushel.

Reported prices in fishermen's logbooks, however, do not specifically indicate whether a particular sale price includes the value of the lease, or not. If a vessel was fishing for a processor using allocation that was owned by the processor, then the vessel will receive a much lower price which reflects harvest services only (currently in the $5.00 - $6.00 range). If a vessel owns its own allocation, then the price for a good-quality bushel of Federal surfclams will be in the $8.00 - $13.00 range. Only the largest, premium surfclams fetch prices in the $14 - $18 range.

Prices for surfclams fell substantially from 1997 to 1998 under slack demand, causing the median price to drop from $12.00 to $10.00 per bushel. In 1999 the price continued to edge downward until stabilizing in the latter part of the year. The demand for surfclams increased in 2000 through 2002, and now continues strong into 2003, leading prices back up to the vicinity of $12.00 per bushel. A significant component of this trend has been due to the widespread substitution of surfclams for ocean quahogs in the marketplace, which had become comparatively unattractive to harvesters because of their lesser value and increasing costs of harvest. The recent price increases for ocean quahogs has helped to increase their desirability to harvesters.

While many vessels will harvest both surfclams and ocean quahogs in a given year, surfclams have always been the preferred catch due to the higher price which they command. While meat yields can vary substantially with geographic location and from year-to-year, the standard government conversion factor is for 1 bushel of surfclams to yield 17 pounds of meats, and has been in use since the 1970s. For the smaller, less-desirable ocean quahog, the accepted standard is for 1 bushel to produce 10 pounds of meats.

For Amendment 13 to this FMP (MAFMC 2003c), the Council hired Dr. Bonnie McCay and her associates at Rutgers University to describe the ports and communities that are associated with the surfclam and ocean quahog fisheries. The researchers did an extensive job of characterizing the surfclam fishery, and the specific details can be viewed in Amendment 13 (MAFMC 2003c).

The majority of the industry would like the surfclam quota to rise to the maximum OY allowed by the current regulations, 3.4 million bushels. Industry was just about as unified on the surfclam quota for 2004 as they had been on any management item in the past 20 years. During the past three years, as staff has developed the recommendation papers for 2001, 2002, and 2003, nearly everyone that staff spoke with was pleased with the Council's motion from March 2000 to "consider an increase in quota to the 3.4 million bushel OY over the next 5 years with a 10% increase in the first year." Staff incorporated the intent of the March 2000 motion (actually an 11% increase rather than the 10% increase in order to return to the quota levels that existed from 1990 through 1994) into their recommendation for the 2001 specification package and that staff recommendation was welcomed warmly by industry. Industry espoused this long range plan (5 years) during the 2001 quota setting, and they all seemed pleased by the Council's action in March of 2000.

For last year's (2003) surfclam quota recommendation, staff recommended a 5% increase to 3.25 million bushels because of the industry's and Council's previously expressed desire to have a long range plan (5 years) to build to the maximum OY level of 3.4 million bushels. Industry was not as unified last year as they were for the 2001 recommendations. Some industry advisors were satisfied with the proposed 5% increase, while several wanted a 10% increase and there was even some sentiment to go all the way to the maximum OY level for 2002 and then again in 2003.

Relative to the surfclam quota for 2004, there was some sentiment for an alternative between the 3.250 million bushel current quota and the maximum of 3.4 million bushels. However, the vast majority believe the 3.4 million quota should be available next year for the industry. Industry's reasoning is that: 1) the last SAW lists surfclams as "under-exploited," 2) all the New Jersey inshore resource has been taken for this fishing year, 3) the vast majority of New York inshore clams are anticipated to be landed in 2003, and 4) the industry has been growing the demand steadily for their product. The Council agreed to build to the 3.4 million bushel maximum at their March 2000 meeting (after reviewing the most recent assessment).

### 5.1.4 Description of the Areas Fished for EFH

Note: Dave Stevenson, Northeast Regional Office (NERO) produced most of the following analyses for the fishing gear impacts workshop of October 2001. In general, the summary conclusions presented here are attributable to that workshop.

Numbers of fishing trips made by Federal vessel permit holders in the northeast United States (North Carolina - Maine) during the period 1995 - 2000 were aggregated for 18 individual gear types and 3 major gear categories (Table 16 of Amendment 13), assigned to 10 minute "squares" of latitude and longitude, and plotted to show spatial distribution patterns. Logbook data included in the analysis are currently provided by vessels operating in Federal waters and participating in the following fisheries: northeast multispecies; sea scallops; surfclams and ocean quahogs; monkfish; summer flounder, scup, and black sea bass; squid, mackerel, and butterfish; spiny dogfish; bluefish; Atlantic herring; and tilefish. Logbook data provided by ocean quahog and surfclam dredge vessels are archived in a separate database and were analyzed separately. Data for lobster pots were provided by vessels with multispecies permits. Vessels that operate strictly within state waters (0-3 miles from shore) are not required to have a Federal permit and therefore do not submit logbooks. For this reason, fishing trips in nearshore 10 minute squares that include a significant proportion of state water were under-represented.

Permit holders are required to submit a vessel trip report each time they make a fishing trip. A trip is defined as a single departure and return to port. Actual fishing time could not be computed because the only temporal datum that was common to all gear types was total trip duration. Although some additional information is available (the number of hauls and average duration of each haul) which could possibly be used to obtain more precise estimates of fishing time for mobile gear types such as bottom trawls and dredges, it is not reported for all trips and is meaningless when applied to stationary gear types such as pots and gill nets. No attempt was made to estimate fishing time for this analysis. Therefore, the results presented here are not intended to represent the spatial distribution of fishing effort.

Permit holders are given the option of reporting the location of a trip as a point (latitude and longitude or Loran bearings) or inside a statistical area. Only trips which were reported as a point location and therefore could be assigned to a 10 minute square were included in this analysis. Trips made south of 35º N latitude (Cape Hatteras) or north of 45º N latitude (U.S.-Canada border in the Bay of Fundy) were excluded from this analysis. Each ten minute square covers an area of 100 square miles or 259 square kilometers.

Plots of the cumulative number of fishing trips by ten minute square were made for each gear type using ArcView. Data were classified using a statistical formula (Jenk's optimization) that identifies natural breakpoints between classes. This is the default classification method used in ArcView. It provided more demonstrable groupings of the data than the other classification methods that were available. For gear types or groups with >150,000 trips, all 10 minute squares with <10 trips were eliminated in order to "clean up" the distribution plots. For gear types with 20,000-70,000 trips, all 10 minute squares with <5 trips were eliminated from the plots; for gears with 4,000-15,000 trips, squares with only a single trip were eliminated; and for gears with <4,000 trips, all trips were used. The number of trips noted at the top of each plot (N) is the number of trips represented in the plot, not (in most cases) the total number of trips.

Overall, 752,681 trips were included in the analysis, representing 79.5% of all trip reports submitted during the six-year period for these 18 gear types (Table 16 of Amendment 13). Most (98.4%) of these trip reports were included in the GIS plots. For individual gears, the "coverage" varied from 30.8 to 100%, with Danish seines ranking the lowest and hydraulic and non-hydraulic clam dredges ranking the highest. For the major gear types (gears with >4,000 analyzed trips), the percentages of reported trips that were analyzed ranged from 72.8 to 100%.

The spatial scale of fishing effort varies depending on which species is the target: surfclams are harvested primarily in a small area off the New Jersey coast whereas ocean quahogs are harvested over a larger area that includes offshore waters. Areas with denser concentrations of clams would presumably be dredged more intensively, i.e., a higher percentage of the bottom would be affected. Since surfclams are concentrated in a very defined area off the New Jersey coast where the bottom is so homogeneous, a high proportion of the bottom over this large contiguous area is affected by dredging. Surfclams grow much more rapidly than ocean quahogs and surfclam beds are dredged every few years. Ocean quahogs are much more likely to be dredged from a number of more or less discrete patches that are surrounded by undisturbed areas. As a general rule, once 50% of the harvestable clams are removed from an area, the catch rates drop to a point where it is no longer economically feasible for fishing to continue there.

In Federal waters, the amount of bottom area directly impacted by the hydraulic clam dredge fleet in 2000 was about 110 square miles (Amendment 13, MAFMC 2003c). An additional 15 square miles were dredged in State waters of New Jersey, New York, and Massachusetts. The predominant substrate on the southern New England/Mid-Atlantic Bight shelf is sand. Thus, during any given year, this fishery is conducted in a very small proportion of a habitat type that characterizes most of the 40,000 square miles of continental shelf between the Virginia/North Carolina border and Nantucket Island (69/ W longitude). The Georges Bank region has been closed to clam harvesting since 1990 because of the potential of paralytic shellfish poisoning.

Trips reported by vessels using hydraulic clam dredges during 1991-2000 were made over a broad area of the continental shelf from Cape Cod to the Delmarva peninsula (Figures 37 and 38 of Amendment 13). Areas where fishing with this gear type was concentrated (235 trips per 100 mi2) were located off the New Jersey coast and south of Long Island. Dredging in southern New England was less intense.

Actual distribution of the surfclam resource can be seen in Figure 1. Review of Figure 6 and Table 4 denote the location of recent landings.

## 5.2 Ocean Quahog *Arctica islandica*

### 5.2.1 Status of the Stock

Ocean quahogs are found in the colder waters on both sides of the North Atlantic. Off the United States and Canada, they range from Newfoundland to Cape Hatteras at depths from 25 feet to 750 feet. Industry has been pressing the limits of current technology in harvesting ocean quahogs as deep as 300 feet in the waters off southern New England. As one progresses northward, ocean quahogs inhabit waters closer to shore.

Ocean quahogs are one of the longest-living, slowest growing marine bivalves in the world. They live to more than 100 years old. Ocean quahogs have been aged in excess of 200 years. They require roughly twenty years to grow to the sizes currently harvested by the industry (approximately 3 inches), and reach sexual maturity between 5 and 10 years of age.

**Note**: the following "State of the Stock," "Management Advice," and "Projections" sections are taken directly from the SARC draft advisory report (August 2000), and therefore are expressed in metric units (1 kg = 2.205 lbs, there are 17 lbs/bushel for surfclams and 10 lbs/bushel for ocean quahogs). Ocean Quahogs will be assessed at the December 2003 SARC.

**State of Stock:** The ocean quahog resource in EEZ waters from Southern New England (SNE) to Southern Virginia (SVA) is not overfished and overfishing is not occurring. The current biomass is high with current catches near MSY. Annual recruitment is approximately 1-2% of stock biomass and lower or roughly equal to the rate of natural mortality. Since the fishery began in the late 1970s, biomass has declined slowly from virgin levels. At current catch levels, biomass is projected to decline gradually over the next decade. The percentage of virgin biomass in the assessed area remaining in 1997-1999 is 88% (all regions).

**Management Advice:** Current fishing mortality is near $F_{target}$ for the resource taken as a whole. However, it may be advantageous to avoid localized depletion.

**Projections (weights in mt of meats):**

| | SVA[1] | DMV | NJ | LI | SNE | GBK | EEZ |
|---|---|---|---|---|---|---|---|
| Estimated Biomass in 1999 (000 mt meats)[2] | 0.079 | 60 | 260 | 530 | 330 | 620 | 1,800 |
| CV[3] | 10% | 18% | 24% | 17% | 13% | 37% | 14% |
| Projected Recruitment (000 mt meats)[2,4] | 0.0035 | 1.5 | 3.9 | 6.5 | 4.1 | 6.8 | 23 |
| Projected Catch (000 mt meats)[5] | 0.0 | 1.2 | 3.3 | 6.0 | 7.3 | 0.0 | 18 |
| Projected Biomass in 2002 (000 mt meats)[2] | 0.089 | 62 | 250 | 512 | 310 | 620 | 1,760 |
| % Change | 12% | 0% | -1% | -3% | -6% | 0% | -2% |

[1]Estimates for SVA not reliable. [2]From KLAMZ delay-difference biomass dynamics model for quahog 70+ mm shell length. [3]Bootstrap, 500 iterations. [4]Constant over time. [5]Mean 1997-1999.

### 5.2.2 Fisheries

| Ocean Quahog Landings: Both State and Federal Waters (Excludes Maine fishery) | | | | | |
|---|---|---|---|---|---|
| Region | 2001 | | | 2002 | |
| | Bushels | Value* | | Bushels | Value* |
| New England States | 1,208,857 | $6,385,499 | | 1,427,561 | 7,675,269 |
| Mid-Atlantic States | 2,482,150 | $13,981,056 | | 2,443,089 | 13,063,415 |
| Total | 3,691,007 | $20,366,555 | | 3,870,650 | 20,738,684 |

Source: NMFS Unpublished Landings Data, Woods Hole, MA
*Values are preliminary estimates. Actual values will be higher.

Since ocean quahogs typically occur in the deeper waters offshore, virtually the entire fishery is prosecuted in Federal waters, with the exception of the Maine inshore fishery. Landings of ocean quahogs from the high-volume fishery outside the State of Maine totaled 3.87 million bushels in 2002, an increase of 4.9% from 2001.

**The Federal Ocean Quahog ITQ Fishery**

The year 2002 saw a continuation of the renewed interest in the ocean quahog fishery, fueled by the sharp price increase of 2001, and the improved efficiency of newly constructed vessels. Landings had been on a declining trend from the 4.9 million bushel peak in 1992. The 2000 harvest of ocean quahogs was the lowest in two decades, with fully 30% of the Federal quota left unharvested on the ocean floor. In 2001 landings jumped almost 17%, and in 2002 increased another 4.9% to 3.87 million bushels.

A total of 31 vessels participated in the 2002 fishery for ocean quahogs in Federal waters apart from Maine. While this count is an increase of only one vessel over 2001, it includes 4 large vessels that were built since the year 2000, and their high productivity is likely to increase utilization of the Federal quota substantially.

Of the 4.5 million bushel quota for 2002, approximately 13,300 bushels were leased to the Maine fishery, 3.87 million were harvested by the industrial fishery outside of Maine, and approximately 616,000 bushels were left unharvested on the ocean floor.

The sharp exvessel price increase of 2001 has been largely sustained in 2002. Reported prices generally ranged from $4.50 to $7.00, with a large percentage at either $6.00 or $6.10 per bushel. Verbal reports from industry members indicate that trucking costs, and whether the vessel owner or processor is responsible, can significantly influence the price paid.

Reported hours of fishing effort deployed in the ocean quahog fishery actually decreased by almost 10% in 2002. The average number of trips taken per vessel declined from 70 to 64.

A fleet-wide calculation of LPUE showed that average landings increased by 15.6% to 126 bushels per hour fished in 2002 (Table 2). Fully 9.2% of this dramatic increase was attributable to three of the newly constructed vessels. When these vessels are excluded, average LPUE of the remaining 28 vessels was 116 bushels per hour fished, or an increase of 6.4% over 2001.

Harvests of ocean quahogs became more concentrated on the high-yielding degree square off eastern Long Island (4072). Fully 49% of the coastwide quota was taken from this square, which showed an increase in LPUE of 9% to 176 bushels per hour fished. The second most heavily fished degree square is the adjacent square to the east, south of Block Island (4071). It supplied 581,000 bushels in 2002, an increase of 83% over 2001.

Some fishing for ocean quahogs does persist in the southern waters off Delmarva (3873 and 3874). Roughly 15% of the 2002 catch was taken from these waters, though their average catch rates have continued to decline to below 90 bushels per hour fished.

Limits on further movement of the fleet to the east were imposed by the closure of surfclam and ocean quahog beds east of the 69/ line since 1990, due to the presence of PSP toxin. Vessels responded to this barrier by pursuing ocean quahogs in the deeper waters further from shore, however there are indications that only limited quantities of ocean quahogs are available in these areas.

### 5.2.3 Economic and Social Environment

Traditionally, the dominant use of ocean quahogs has been in such products as soups, chowders, and white sauces. Their small meat has a sharper taste and darker color than surfclams, which has not permitted their use in strip products or the higher-quality chowders. With their lower exvessel price (approximately $6.00 per bushel in 2002 for the full “lease plus harvest” value), ocean quahogs have historically been a bulk, low- priced food item. As in other fisheries such as Atlantic mackerel, the industrial ocean quahog fishery has only been viable when large quantities could be harvested quickly and efficiently. When catch rates fell below a certain point, vessels tended to shift their effort to higher-yielding areas.

As will be discussed in more detail in the following sections, there had been a shift toward greater utilization of the lower-priced ocean quahog meats in the years 1997 and 1998. Both years saw almost all of the ocean quahog quota harvested, while surfclam quota was left unharvested on the ocean floor. However this trend reverted back to the historical norm in 1999 as fuel prices spiked, and it became relatively more expensive to harvest ocean quahogs which are found farther offshore. Higher fuel prices combined with the increasing scarcity of dense ocean quahog beds have resulted in an overall decline in ocean quahog harvests. Industry focus returned to surfclams and they harvested nearly all of the Federal 1999 surfclam quota, while leaving 16% of the ocean quahog quota unharvested.

The trend became even stronger in the year 2000, which saw ocean quahog harvests (apart from Maine) plummet 16% to 3.161 million bushels, a level not seen in two decades. Again, the principal reason behind the fall is not a lack of demand, as demand is currently strong for both surfclams and ocean quahogs. The continued thinning of ocean quahog beds that have required decades to develop has combined with low dockside prices to the point where processors had great difficulty in convincing vessels to fish for them. A resurgence of interest occurred in 2001 as buyers increased prices dramatically to the $6.00 - $7.00 per bushel level, and vessels concentrated their efforts on some of the few remaining high-yield areas.

For Amendment 13 to this FMP (MAFMC 2003c), the Council hired Dr. Bonnie McCay and her associates at Rutgers University to describe the ports and communities that are associated with the surfclam and ocean quahog fisheries. The researchers did an extensive job of characterizing the ocean quahog fishery, and the specific details can be viewed in Amendment 13.

The majority of industry that staff spoke with felt that the ocean quahog quota should be increased over the 2003 quota level (4.5 million bushels). Several participants (both fishermen and processors) raised concerns that have been raised the past few years, that all the easily accessible, virgin, ocean quahog beds had been fished and the current price per bushel is constraining to fishing less-dense/less-desirable beds of ocean quahogs. A representative of the processing sector again stated that the group he represented was nearly desperate to find boats willing to fish for ocean quahogs. Four new clam vessels will be added to the fleet in 2002. Three of these new vessels are 116 feet long and carry 112 cages of clams. Several industry members believe that these new vessels will go far in helping the industry land the 4.5 million quota for 2003. Furthermore, industry members believe that if they do land the full 4.5 million bushel quota for 2003, then there would need to be an increase for 2004. Some in industry argue that: 1) based on the last SAW, ocean quahogs are not "overfished and overfishing is not occurring," 2) nearly all the surfclam meats (both inshore and EEZ) will be taken in 2003 as occurred in2001 and 2002, and 3) the new vessels will be fishing in 2003 and 2004.

### 5.2.4 Description of the Areas Fished for EFH

Note: Dave Stevenson (NERO) produced most of the following analyses for the fishing gear impacts workshop of October 2001. In general, the summary conclusions presented here are attributable to that workshop. Please see section 5.1.4 for a full description of Dave Stevenson's analyses.

The spatial scale of fishing effort varies depending on which species is the target: surfclams are harvested primarily in a small area off the New Jersey coast whereas ocean quahogs are harvested over a larger area that includes offshore waters. Areas with denser concentrations of clams would presumably be dredged more intensively, i.e., a higher percentage of the bottom would be affected. Because surfclams are concentrated in a very defined area off the New Jersey coast where the bottom is so homogeneous, a high proportion of the bottom over this large contiguous area is affected by dredging. Surfclams grow much more rapidly than ocean quahogs and surfclam beds are dredged every few years. Areas dredged for ocean quahogs are left untouched for many years. Ocean quahogs are much more likely to be dredged from a number of more or less discrete patches that are surrounded by undisturbed areas. It was noted, as a general rule, that once 50% of the harvestable clams are removed from an area, the catch rates drop to a point where it is no longer economically feasible for fishing to continue there.

In Federal waters, the amount of bottom area directly impacted by the hydraulic clam dredge fleet in 2000 was about 110 square miles (Amendment 13). An additional 15 square miles were dredged in State waters of New Jersey, New York, and Massachusetts. The predominant substrate on the southern New England/Mid-Atlantic Bight shelf is sand. Thus, during any given year, this fishery is conducted in a very small proportion of a habitat type that characterizes most of the 40,000 square miles of continental shelf between the Virginia/North Carolina border and Nantucket Island (69/ W longitude). The Georges Bank region has been closed to clam harvesting since 1990 because of the potential of paralytic shellfish poisoning.

Trips reported by vessels using hydraulic clam dredges during 1991-2000 were made over a broad area of the continental shelf from Cape Cod to the Delmarva peninsula (Figures 37 and 38 of Amendment 13). Areas where fishing with this gear type was concentrated (235 trips per 100 square miles) were located off the New Jersey coast and south of Long Island. Dredging in southern New England was less intense.

Actual distribution of the ocean quahog resource can be seen in Figure 2. Review of Figure 6 and Table 5 denote the location of recent landings.

### 5.3 Maine Ocean Quahog *Arctica islandica*

#### 5.3.1 Status of the Stock

The NMFS collected non-random samples from the coast of Maine with the 1992 and 1994 research surveys in order to map the distribution (MAFMC 1998) of ocean quahogs and to examine the population size frequency distributions. Within the 50 fathom range, ocean quahogs appear to be restricted to a patch centered between 67$^{o}$ and 68$^{o}$ W longitude. Tows were taken to the east and west of the patch to attempt to define the limits. The location of the patch, as defined by survey data, agrees well with the location of recent landings. Maine is the only area with any evidence of substantial recruitment of small quahogs or of growth by medium-sized ocean quahogs in any region (USDC 1995).

In the Maine area, the population consists of two length modes (MAFMC 1998). The larger group is centered between 50 and 54 mm (25 mm = 1 inch) shell length. Most clams in the smaller group measured 20-29 mm in July 1992, and 30-39 mm in August 1994. Work is currently in progress to section these shells and estimate age and growth. Based on the work of Kraus *et al*. (1992) the 50-54 mm long clams would be 35-43 years of age. The smaller group, 30-39 mm long, would be 15-20 years of age (USDC 1995). However, information from Maine ocean quahog fishermen indicates that growth rates may be greater than that calculated by Kraus *et al*. (1992) and this should be the subject of further research.

The 1994 assessment (USDC 1995) states that given the problems with the 1994 survey, it would be inappropriate to use the two surveys to make inferences about changes in population size, because those samples were from nonrandom locations. It is extremely difficult to fish these small concentrated beds with a vessel the size used by NMFS because of bottom obstructions.

The ocean quahog is among the longest-lived and slowest growing of marine bivalves worldwide. Growth studies indicate that ages in excess of 100 years are common and longevity past 200 years is documented. There is contradictory evidence about growth rates for ocean quahogs in this area. Recent growth studies conducted off eastern Maine (Kraus *et al*. 1992) indicated a maximum age of 66, but substantially slower rates of growth than for Mid-Atlantic Bight individuals (MAFMC 1998).

Studies of growth in ocean quahogs (Murawski *et al*. 1982; Ropes and Pyoas 1982; and Kraus *et al.* 1992) reveal strong regional differences in the relationship between shell length and age (MAFMC 1998). In their natural environment, quahogs off the coast of Maine grow slower than quahogs from the south. For example, at a length of 40 mm (1.5"), which is the typical size at which this species matures, clams from Maine, Long Island, and Georges Bank would be approximately 23, 8, and 5 years old, respectively (MAFMC 1998). Kraus *et al*. (1992) demonstrated that quahogs from Maine grew as fast as those from southern regions when they were raised in the laboratory (MAFMC 1998). Lutz *et al*. (1983) found similar results. These studies demonstrate the potential for ocean quahogs from Maine to grow more rapidly, and they demonstrate that growth is limited by conditions in their natural environment.

In the absence of a formal stock assessment or even a survey of abundance, it is impossible to quantify the stock status of ocean quahogs off of the coast of Maine. However, there are a number of other sources of information from which one can derive a qualitative understanding of the stock's status.

Since the fishery's inception in the late 1970s, fishing activity has remained focused on a few well-known beds of ocean quahogs. The center of effort shifts no more than a mile or two from year to year. Since landings in this fishery are believed to be driven by market demand (they are demand-limited not resource-limited, see section 7 for details), interannual changes in total landings are not reliable indicators of abundance. A better proxy is catch-per-unit-effort (CPUE). Logbook data show a general increase from approximately two bushels per hour fished at the inception of the experimental fishery in 1991 to over seven bushels per hour fished in 1995 (MAFMC 1998).

Unlike the mid-Atlantic portion of the ocean quahog resource, the ocean quahog resource off of eastern Maine produces strong year classes of settled spat and new recruits. Harvesters report that portions of a bed which have been fished down are quickly repopulated with spat and produce new populations of commercial-sized clams (1.5 inches) in fishable abundance in as little as seven years (but note that this differs from the results reported by Kraus *et al.* 1992 above). Since the market for eastern Maine ocean quahogs will not take a clam over 2 - 2.5 inches , the most productive segment of the spawning stock enjoys *de facto* protection and is returned to the beds. These two points are probably related. Additionally, some of the fishermen regularly engage in informal restocking experiments; retaining all the oversized clams from a day's fishing and moving them to more inshore areas which they believe should support a quahog population and a safer winter fishery (Finlayson pers. comm.).

Amendment 10 (MAFMC 1998) emphasized that there had been no comprehensive, systematic survey or assessment of the ocean quahog resource in eastern Maine. It also emphasized that a full stock assessment of the Maine resource should be a priority to ensure that this segment of the fishery would have a sustainable future. The initial maximum quota for the Maine zone was to remain in effect until a resource survey and assessment was completed. The agreement at the time of Amendment 10 was that the State of Maine was to initiate a survey once the initial maximum quota of 100,000 bushels became constraining. There was an effort within the State of Maine to initiate an ocean quahog survey in 2002. Scott Feindel has been hired and is currently working with a commercial fishermen to survey the distribution of the resource along the Maine coast.

### 5.3.2 Fisheries

According to 50 CFR section 648.76 (2)(b)(iv): *The Regional Administrator will monitor the quota based on dealer reports and other available information and shall determine the date when the quota will be harvested. NMFS shall publish notification in the Federal Register advising the public that, effective upon a specific date, the Maine mahogany quahog quota has been harvested and notifying vessel and dealer permit holders that no Maine mahogany quahog quota is available for the remainder of the year.*

It must also be remembered that according to 50 CFR section 648.76 (2)(b)(iii): *All mahogany quahogs landed by vessels fishing in the Maine mahogany quahog zone for an individual allocation of quahogs under section 648,70 will be counted against the ocean quahog allocation for which the vessel is fishing.* In other words, even after the initial maximum quota of 100,000 Maine bushels is harvested from the Maine mahogany ocean quahog zone (north of 43°50'), vessels could obtain/use ITQ allocation and continue to fish in this zone. It is anticipated that some Maine fishermen will again rent ITQ allocation after the 100,000 bushel quota is reached in 2003 and 2004 as they have done for the past two years. More than half (4,530 bushels) of the 8,500 bushels that were above the 100,000 quota in 2001 were landed with an ITQ allocation. In 2000, there were 5,821 bushels landed with ITQ shares of the 20,767 bushels that exceeded the 100,000 bushel quota. Of the 128,574 Maine bushels landed in 2002, 13,231 bushels were leased from the ITQ fishery and the remaining 15,343 bushels represent an overage of the 100,000 bushel quota. There were no quota overages prior to 2000. Since implementation of Amendment 10 in 1998, approximately 70 % of the average annual landings have been reported as coming from state waters and 30% from Federal waters.

### 5.3.3 Economic and Social Environment

Relative to the Maine ocean quahog resource and PSP, John Hurst (pers. comm.) reports that the summer of 2001 was a very bad year for PSP in Maine waters whereas 2002 was not bad after an initial episode in May. The waters during 2001 were warm and there was low freshwater flow from precipitation. Maine waters were totally closed for nearly four weeks and some areas were closed for as long as six weeks in 2001. In 2002 there was a PSP closure for mussels and the ocean temperature was again warm in May, but then storms and lower than normal water temperatures minimized the appearance of PSP. Prior to 2001 there had not been any toxins reported in ocean quahogs for the previous four or five years. Maine has a fairly extensive sampling and testing program, which collects samples both at sea and from dealers on shore. In 2003, there have been no PSP closures by early June 2003.

Amendment 10 implemented management of the Maine ocean quahog fishery in May 1998. The initial quota was set at 100,000 bushels and was again set at that level every year since. Representatives of Maine all encouraged the Council to maintain that quota for 2004. Issues of under-reporting of the catches have apparently improved since 1998, when Maine wrote all their permit holders explaining that they needed to report the landings to NMFS. It is hoped that ACCSP will also help improve any misreporting of data. The State of Maine has recently hired a biologist, Scott Feindel, who is currently conducting a preliminary ocean quahog survey with a hired commercial vessel. It is planned that Maine surveys will be conducted in 2002 and 2003 followed by a stock assessment that will be peer-reviewed through the SARC/SAW process with the December 2003 regular ocean quahog assessment that follows this summer's NMFS clam survey. The state researchers, as well as nearly everyone associated with the clam industry, would like to see a Maine survey and assessment so that the Maine ocean quahog quotas could be based on better biological information.

For Amendment 13 to this FMP (MAFMC 2003c), the Council hired Dr. Bonnie McCay and her associates at Rutgers University to describe the ports and communities that are associated with the surfclam and ocean quahog fisheries. The researchers did an extensive job of characterizing the Maine ocean quahog fishery, and while all their findings are not included here, the following paragraphs in this section add significantly to the knowledge that was available previously.

Thirty-three vessels with Maine ownership reported ocean quahog landings in 2000, a marked decline from the 82 vessels licensed in 1996. These vessels harvested approximately 120,000 bushels. This is more than the Maine ITQ allocation. The additional landings were possible through the leasing of allocation from other companies holding ITQ shares. Some informants indicate that leasing is essential to their business. This is especially true for those vessel owners who do not participate in other local fisheries and for vessel owners who are also dealers. Dealers must have a continuous supply to their markets or else their markets will look elsewhere for product. Others in the Maine fishery do not lease allocation from outside ITQ holders, because doing so represents a risk they feel they cannot afford to take. Leased allocation is relatively expensive and if not used by the end of the year is lost. A common alternative to leasing quota is to rely on other fisheries (mainly urchins and scallops) when the Maine quota allocation has been reached.

Approximately 76 percent of the Federally-permitted, Maine vessels that landed ocean quahogs in 2000 listed addresses in the towns of Addison, Beals Island, and Jonesport. The remaining vessels came from Machiasport, Roque Bluffs, Steuben, Winter Harbor, Columbia Falls, Harrington, and Cutler. In 2000, over two-thirds of the ocean quahogs were landed in Jonesport. Other towns with recorded landings were Steuben, Addison, South Addison, Eastern Harbor, Beals Island, and Bucks Harbor.

Official statistics and published data on this fishery do not exist beyond permit lists and aggregate landings reports. Based on interviews done in November 2001, it appears that typical vessels are owner operated. However, some individuals own up to four ocean quahog boats. Some vessels are owned by dealers who hire captains to operate them. In general, each vessel has a crew of 3-4 men (including the captain). The crewmembers are generally hired locally. Some crewmembers come and go while others have fished for the same boat (or boat owner) for several years. In general, vessel owners do not have trouble finding good crew, but some report that when they find good, reliable crew, they do what they can to keep them. Many vessels also participate in other fisheries such as lobster, scallops, mussels, urchins, and periwinkles. Several vessels rely solely on ocean quahogs, often because they do not hold permits in other fisheries.

In 2000, 9 dealers purchased ocean quahogs. As expected, most of the dealers are located in or around Jonesport and nearby Beals Island. Other dealers purchasing ocean quahogs in Maine listed addresses in Machias, Cushing, Stonington, Brooklin, and Bucks Harbor. In general, dealers tend to rely on a few "core" vessels and purchase from other vessels on a sporadic basis. Owning vessels is another strategy utilized by several dealers. This ensures them a continuous supply to send to their markets. Most dealers also buy and sell a variety of other fishery products, such as lobsters, scallops, mussels, soft-shell clams, crabs, and periwinkles. Some companies handle only ocean quahogs. Generally, each dealer employs between 1-3 individuals (in addition to vessel crew).

Generally, the Maine ocean quahog is destined for the fresh, half shell market. The ocean quahogs, therefore, are also trucked to markets, mostly outside of Maine. Some of the ocean quahogs are sent to other dealers in Maine, but most are shipped out of state directly. Several dealers send trucks to different ports to pick up ocean quahogs. There are several local trucking companies that ship the ocean quahogs to market, and some dealers also own their own trucks.

In Jonesport, the center of the fishery, there are four main wharves that handle ocean quahogs, including the public marina. However, several of these simply represent space leased out to vessel owners. The vessel owners hire their own crew and independently handle their own operations. Other vessel owners moor their vessels in other ports and land their vessels at the wharves utilized by the dealers to whom they sell.

### 5.3.4 Description of the Areas Fished for EFH

Note: Dave Stevenson (NERO) produced most of the following analyses for the fishing gear impacts workshop of October 2001. In general, the summary conclusions presented here are attributable to that workshop. Please see section 5.1.4 of Amendment 13for a full description.

The dry dredge used in the Maine fishery is a cage with wide skis and a series of teeth about 6 inches long in the front. These dredges are used on smaller boats (about 30 to 40 feet long) and are pulled through the seabed using the boat's engine. The cutter bar is limited to a width of 36 inches by State law. This fishery takes place in small areas of sand and sandy mud found among bedrock outcroppings in depths of 30 to > 250 ft in state and Federal coastal waters north of 43 degrees 50' N latitude. The dredges scoop up clams and sediment, and the vessel's propeller wash is used to clean out the sand and mud.

The concentration of the "dry" dredge in the Maine ocean quahog fishery is depicted in Figure 39 of Amendment 13.

## 6.0 ENVIRONMENTAL IMPACTS OF THE ALTERNATIVES

### 6.1 Surfclam *Spisula solidissima* Quota

### 6.1.1 Impacts of Preferred Alternative (3.400 million bushels) on the Environment

The Council's preferred alternative quota for 2004 is 3.400 million bushels, which is a 4.6% increase from the 2003 quota of 3.250 million bushels. This preferred alternative meets the 2000 SAW recommendation: "Fishing mortality can be increased for the surfclam resource taken as a whole. However, it may be advantageous to avoid localized depletion."

**<u>Summary Justification for Surfclam 3.400 Million Bushel Quota Recommendation</u>**

At its June 2003 meeting on the surfclam quota for the coming year, the Mid-Atlantic Council hosted extensive public debate on the issue of whether the quota should be set at 3.4 million bushels, or some other level.

The following points represent the key factors that led the Council to adopt the 3.400 million bushel maximum level for 2004.

> Over 99% of the 3.135 million bushel quota was harvested from Federal waters in 2002, reflecting the continued strong demand for clam products following the lull that occurred in 1997 and 1998.
>
> Exvessel prices increased again in 2002, with 62% of the vessel trip reports showing prices of $11.00 per bushel and above, compared with 33% of trips in 2001. Preliminary data from 2003 indicate that most trips have been selling in the $10.50 - $13.00 per bushel price range.

Hours of fishing effort deployed in the Federal surfclam fishery increased by a substantial 19% in 2002, augmented by the participation of 4 additional vessels. Note that this increase followed on the heels of a massive 25% increase in 2001.

A fleet-wide calculation of Landings Per Unit of Effort (LPUE) declined 8.7% to 105 bushels per hour fished in 2002 (Table 1). Stated alternatively, a 19% increase in fishing effort was used by the industry to harvest a 9% increase of the Federal surfclam quota.

The decline in surfclam LPUE would have been greater if not bolstered by the high productivity of a single, large new vessel launched in 2002.

Harvests continue to be heavily concentrated off the coast of New Jersey, with 43% of the coast-wide catch coming from the "New Jersey Nearshore" (3973) degree square (Table 4). Average LPUE of all vessels decreased 3% in this square, while the total harvest decreased 10% to 1.3 million bushels.

It is worthy of note that the second most intensively fished degree square in 2002 was not off New Jersey, but down in the southern waters off the Delmarva peninsula (3874). Both industry and fishery managers alike have been looking for an improved utilization of the denser, lower-yielding clams in this area. Harvests increased by 143% to 611,000 bushels in the square, while LPUE declined by 9%.

**Biological Impacts**

The most recent biological assessments that the Council had for their deliberations (from both the 1997 and 1999 surveys) indicate the resource is healthy, composed of many age classes, and can safely sustain increased harvests. Sufficient recruitment is also evident and thus this level of quota will not harm the long-term sustainability of the resource. These facts were again confirmed in the June 2003 surfclam assessment which was presented to the Council in August. The F in 2002 associated with a quota of 3.135 million bushels was approximately 0.03 and this quota increase will result in the F in 2004 of about 0.03 also.

The proposed quota takes into account analysis of surfclam abundance that was part of the 30th Northeast Regional Stock Assessment Workshop (SAW 30). SAW 30 utilized data from the 1999 surfclam survey, which included work to estimate dredge efficiency. Results from the 1999 survey and assessment corroborate those of the 1997 survey and assessment and provided the Council the opportunity to safely increase the quota. The Council has tentatively agreed with industry's request to continue increasing the quota up to the maximum optimum yield (3.4 million bushels) level. The Council will continue to perform its annual review of the fishery, but wanted industry to understand that should future assessments continue to indicate the healthy status of the resource that the industry can plan for continuation of its maximum optimum yield level.

The Council continues to assume that none of the Georges Bank resource (approximately twenty percent of the total resource) will be available in the near future for harvesting because of paralytic shellfish poisoning. This area has been closed to the harvest of clams and other shellfish since 1989, and the Council and NMFS have no reason to believe that it will reopen in the near future.

Amendment 12 (MAFMC 1999) proposed an ocean quahog overfishing definition based on MSY that encompassed the entire resource within the US EEZ. This definition included both biomass and fishing mortality threshold and target estimates. This definition was approved by the Secretary with his approval of that Amendment. The proposed surfclam overfishing definition in Amendment 12 was conservative but was not certifiable by the NEFSC and thus not approved by the Secretary because the definition was based only on the fished proportion of the surfclam population rather than all the surfclam resource in the US EEZ. The new proposed definition in Amendment 13 (MAFMC 2003c) is similar to the one for ocean quahogs in that it is global, MSY based, and has both biomass and fishing mortality threshold and target estimates. Both definitions have control rules (Figure 1 for surfclams and Figure 22 for ocean quahogs of Amendment 13).

Under the definition recommended by the 2000 SARC and unanimously approved by the Council, overfishing for surfclams occurs whenever F exceeds the threshold fishing mortality rate. The threshold fishing mortality rate is $F_{MSY}$, but reduced in a linear fashion towards zero when stock biomass falls below the biomass threshold value ($1/2B_{MSY}$). The surfclam stock is overfished whenever stock biomass falls below the biomass threshold level. Estimates of fishing mortality and biomass thresholds and the biomass target based on MSY can be expected to change in each assessment as data accumulate and models improve.

The pre-SFA overfishing definitions for surfclams and ocean quahogs, as they were defined in Amendment 9 (MAFMC 1996) needed revision because those definitions were 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 of Amendment 12 on maximum sustainable yield summarized the history of MSY calculations for surfclams and ocean quahogs and described 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. The Council is no longer focused on the 10 and 30 year supply horizons for these two species as they are relying on the approved overfishing definition for ocean quahogs and the proposed definition for surfclams. The Council used these benchmarks for their annual quota setting since the 2000 stock assessments (USDC 2000a and 2000b) were completed.

It must be remembered that there has been effective management of both surfclams and ocean quahogs for the past 25 years. The Council began management of these two resources with the FMP in 1977. (It was the first FMP in the country under the 1976 Magnuson Fishery Conservation and Management Act.) The surfclam resource had collapsed from overfishing (landings plummeted from 96 million pounds in 1974 to 35 million pounds in 1979; Table 1 of Amendment 8) and there was serious Council consideration given to closing the fishery for a few years entirely. A low quota was implemented and by the mid 1980s the resource was rebuilt and the quotas were increased to near what they are today. The original FMP had an MSY estimate of 50 million pounds of meats. This is near the top of the FMP’s OY range of 58 million pounds.

The EEZ surfclam resource is where the vast amount of landings come from annually (Table 33 of Amendment 13), however all three areas (EEZ, New Jersey Territorial Sea, and New York Territorial Sea) have roughly the same exploitation rate. It appears that all three areas are currently managed on a sustainable level.

In summary, the Council has prevented overfishing of these two resources for the past 25 years and fully intends to continue doing so.

**Socioeconomic Impacts**

The socioeconomic impacts of this alternative are discussed in detail in the Regulatory Impact Review (RIR) Sections RIR 7.1.2. and RIR 8.2.2. In sum, this alternative is expected to result in a slight increase in both consumer and producer surplus, and would increase the average gross value of the harvest per allocation holder by $17,647.

**Essential Fish Habitat Impacts**

The Sustainable Fisheries Act (SFA) of 1996 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 to suggest conservation and enhancement measures. These new habitat requirements, including what is known about clam gear impacts to the bottom, were addressed in Amendment 12 (MAFMC 1999) and more thoroughly in Amendment 13 which is being reviewed by the Secretary currently.

The Council assumed the panel of experts assembled at the fishing gear workshop in October 2001 provided the best synthesis of the existing scientific knowledge and the best management recommendations. The workshop panel concluded that the habitat effects of hydraulic dredging were limited to sandy substrates, since the gear is not used in gravel and mud habitats (MAFMC 2003c). Two effects -changes in physical and biological structure – were determined to occur at high levels. The evidence cited for these two effects was a combination of peer-reviewed scientific literature, gray literature, and professional judgement. There are no effects of hydraulic dredges on major physical features in sandy habitat because, in the panel's view, there are no such features on sandy bottom. Panel members evaluated changes to benthic prey as unknown.

Dr. William DuPaul (VIMS) led the discussion at the fishing gear impacts workshop on the types of management actions that could be taken to minimize adverse impacts of hydraulic dredging to benthic habitat. The following two paragraphs are taken from that report (Appendix 4 of MAFMC 2003c).

The effectiveness of the Individual Transferable Quota (ITQ) management program since 1990 and the opinion that the two resources are underfished, led the panel to conclude that reductions in effort are probably not practicable. Nor is it likely that gear substitutions or modifications are practical since the current gear is highly efficient at harvesting clams. Therefore spatial area management seems to be the only practicable approach to minimizing gear impacts, if necessary.

It was emphasized that hydraulic dredges are designed to operate in sandy substrate. This gear could be very destructive if fished in the wrong sediment type or in structured environments like gravel beds or tilefish pueblo villages. The panel emphasized the gear should not be used in sediment types where it would cause more damage. Areas of known structure-forming biota should be mapped and set aside as a priority. It was emphasized that since we really do not know what the effect of this gear is to soft-bodied benthic organisms, a possible precautionary measure would be to restrict the fishery to areas of high clam productivity. Seasonal closures were mentioned if times and areas of high recruitment could be detected.

The temporal scale of the effects varies depending on the background energy of the environment. Recovery of physical structure can range from days in high energy environments to months in low energy environments, whereas biological structure can take months to years to recover from dredging, depending on what species are affected.

The workshop panel agreed that hydraulic dredges have important habitat effects, but even in a worse case scenario, where there were known to be severe biological impacts, only a small area is affected and therefore this gear type is less important than other gear types like bottom trawls and scallop dredges which affect much larger areas. It was also pointed out, however, that even though the effects of dredging (at least for surfclams) are limited to a relatively small area, localized effects of dredging on EFH could be very significant if the dredged area is a productive habitat for one or more managed fish resource. The same would be true if dredging in a particular area coincided with a strong settlement of larval fish. A major question for this gear that the panel asked was "what are its long-term biological impacts" *i.e.*, how, and to what extent, are benthic communities altered in heavily dredged areas, particularly the prey organisms, and how long does it take for them to recover once dredging ceases?

The Council concluded from the above identified workshop (Appendix 4 of Amendment 13) that there is sufficient information that clam dredges could have an effect on EFH if the gear is fished improperly or in the wrong sediment type. For example, hydraulic clam dredges would have a significant impact to a coral reef or an SAV bed if such gear were used in a stable, fragile, structured, environment like one of those environments. However, the clam resources are concentrated in high energy sandy sediment and the fishing gear has evolved over the past five decades to fish most efficiently in this type of sandy sediment. This evolution of the fishing gear has minimized the effect on fishery habitat (Wallace and Hoff in press). Natural events have more effect on the benthic community than this type of fishing gear since all of the fishing activity takes place in sandy shallow water. Chiarella *et al.* (2002) describing the October 2001 workshop concluded that hydraulic clam dredges were not a major concern relative to otter trawls and scallop dredges. All of the hydraulic clam dredging for an entire year, would impact about 100 square miles of bottom (Table 2 of MAFMC 2003c). In context, this 100 square miles is roughly the area of one ten minute square, and there are over 1200 ten minute squares in the EEZ between Cape Hatteras and Georges Bank. Thus, it does not appear that either surfclam or ocean quahog EFH is effected by fishing gear.

A qualitative EFH vulnerability analysis conducted by Stevenson *et al.* (2003) suggests that the EFH of several species may be vulnerable to impacts associated with the use of hydraulic clam dredges. This includes black sea bass (juveniles and adults), scup (juveniles), ocean pout (all life stages), red hake (juveniles), silver hake (juveniles), winter flounder (juveniles and adults), and Atlantic sea scallops (juveniles) (See section 2.2.5.5.2 of MAFMC 2003c).

Based upon existing information the Council concluded that there may be potential adverse effects on EFH from the hydraulic clam dredge, but concurred with the workshop panel (Appendix 4of MAFMC 2003c). The panel concluded that as the clam fishery is currently prosecuted, in sand habitats, there are potentially large, localized impacts to biological and physical structure, however the recovery time is relatively short. Since the recovery time is relatively short (hours to months) the adverse impacts to this high energy environment can be considered temporary. The preamble to the EFH Final Rule (50 CFR Part 600) defines temporary impacts as those that are limited in duration and that allow the particular environment to recover without measurable impact. Since these impacts are potentially effecting a relatively small portion (approximately 100 square nautical miles) of the overall large uniform area of high energy sand along the continental shelf (approximately 54,900 square nautical miles) these adverse impacts can be considered minimal. Additionally, the 100 square nautical miles impact each year (approximately 1.5 ten minute squares of latitude and longitude) represents a small fraction of the total EFH of the above listed vulnerable EFH and species. The preamble of the EFH Final Rule defines minimal impacts as those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions.

Although the Council has concluded that the clam fishery has an adverse effect on EFH that is no more than minimal and temporary in nature, there is enough uncertainty to warrant the evaluation of other measures that may be taken in light of this uncertainty. Based upon guidance from the Assistant Administrator (January 22, 2001), if information is inconclusive, a NEPA analysis should examine alternatives that could be taken in the face of uncertainty. For NEPA purposes, the guidance from the Assistant Administrator stated that the analysis of alternatives needs to consider explicitly a range of management measures for minimizing potential adverse effects, and the practicability and consequences of adopting those measures. The advice from Dr. Hogarth continues: "In other words, if there is evidence that a fishing practice may be having an identifiable adverse effect on EFH, even if there is no conclusive proof of adverse effects, it is not sufficient to conclude *prima facie* that no new management measures are necessary without first conducting a reasonably detailed alternatives analysis."

The Council evaluated nine alternatives that focused mostly on closed areas. The fishing gear impacts workshop (Appendix 4 of Amendment 13) concluded that effort reductions (i.e. harvest limits) and gear modifications (i.e. restrictions) were not workable for this fishery and that if the clam dredges were found to have significant adverse effects on EFH, then spatial closures were the only viable alternative to mitigate the adverse effects of this fishing gear. Since surfclams are underfished and the annual quotas are actually being increased, it seems to make little sense to restrict harvest limits for EFH reasons, however there is an alternative for analysis where the ocean quahog optimum yield range would be reduced to trade off against an increase in surfclam quota. Finally, seven potential closed area alternatives were identified. These closed areas are being considered to be closed to clam dredging for 5 years. The distribution of the surfclam and ocean quahog resources based on the 1999 survey are depicted in Figures 5 through 8 of Amendment 13. Landings of the two species in 2000 are shown in Figures 9 and 10 of Amendment 13.

Of the nine alternatives that the Council considered initially relative to fishing gear impacts to EFH, four were thoroughly evaluated for their biological, economic, and social impacts. The Council did not thoroughly evaluate alternatives 5, 7, 8, and 9 for social and economic impacts, because they determined that these closures were not reasonable with all of the data uncertainties associated with each alternative. The Council eliminated alternative 4 for thorough evaluation because it is in shallow water and storm events are much more significant at causing sediment disturbances in those depths than is hydraulic clamming activity.

This NEPA analysis is detailed in section 7 (Essential Fish Habitat Assessment) of this EA, based on the conclusions that the impacts are temporary and minimal. The Council has concluded that any small quota increase minimizes, to the extent practicable, the adverse effects of fishing on EFH as required by section 303 (a) (7) of the MSA.

**Protected Resources Impacts**

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 114 of the Marine Mammal Protection Act (MMPA) of 1972. In addition, the proposed actions will not significantly increase fishing effort. Clam vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery.

### 6.1.2 Impacts of Alternative S1 (1.850 million bushels) on the Environment

The first non-preferred alternative quota for the 2004 surfclam fishery is1.850 million bushels. This quota is within the OY range of between 1.850 and 3.400 million bushels as required by the FMP. This alternative would reduce the surfclam quota by 43.1% from 2003 (MAFMC 2003a).

There is no major reason the Council would have considered seriously reducing the 2004 quota from the 2003, other than to evaluate the full range of alternatives.

**Biological Impacts**

A 43.1% reduction in quota for 2004 could possibly benefit the long-term sustainability of the resource, however there is the offsetting argument that the slow growing clams off of Delmarva may need to be thinned in order to be more productive. (The 1998 assessment (USDC 1998a) states: “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.”) The annual impacts on bottom habitat may be slightly lessened with a reduction in quota.

Discounting the availability of the resource on Georges Bank there is sufficient resource in the Northern New Jersey and Delmarva areas to maintain a quota significantly above this level. The biology of the resource does not warrant constraining the industry to this level at this time. This level of quota may not have significantly different effects on the resource (since more may die of natural mortality), but may have a somewhat more beneficial effect on bottom habitat than the preferred alternative, since there would be less fishing effort.

**Socioeconomic Impacts**

The socioeconomic impacts of this alternative are discussed in detail in the Regulatory Impact Review (RIR) Sections RIR 7.1.3. and RIR 8.2.2. In sum, this alternative is expected to result in a significant decrease in both consumer and producer surplus, and would reduce the average gross value of the harvest per allocation holder by $164,706.

**Essential Fish Habitat Impacts**

The discussion of the preferred alternative details why the Council concluded that clam fishing gear impacts are temporary and minimal. Potentially, the less the quota, the less the temporary and minimal impacts realized.

**Protected Resources Impacts**

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Clam vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery. Potentially, the less the quota, the less any impact would be.

### 6.1.3 Impacts of Alternative S2 (3.135 million bushels) on the Environment

The second non-preferred alternative quota for the 2004 surfclam fishery is the quota from 2002of 3.135 million bushels. This quota is within the OY range of between 1.850 and 3.400 million bushels as required by the FMP. This alternative would maintain the surfclam quota at the level it was in 2002 (MAFMC 2003a).

**Biological Impacts**

Returning to the quota level of 2002could possibly affect the long-term growth of the industry, if industry is correct and the demand is growing. There is the argument that the slow growing clams off of Delmarva may need to be thinned in order to be more productive or may never become more productive. (The assessment (USDC 1998a) states: "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.")

**Socioeconomic Impacts**

The socioeconomic impacts of this alternative are discussed in detail in the Regulatory Impact Review (RIR) Sections RIR 7.1.4. and RIR 8.2.2. In sum, this alternative is expected to result in a decrease in both consumer and producer surplus, and would reduce the average gross value of the harvest per allocation holder by $13,529.

**Essential Fish Habitat Impacts**

The discussion of the preferred alternative details why the Council concluded that clam fishing gear impacts are temporary and minimal. Potentially, the less the quota, the less the temporary and minimal impacts realized.

**Protected Resources Impacts**

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Clam vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery. Potentially, the less the quota, the less any impact would be.

### 6.1.4 Impacts of Alternative S3 (3.250 million bushels) on the Environment (No action)

The third non-preferred alternative quota for the 2004 surfclam fishery is the status quo of 3.250 million bushels. This quota is within the OY range of between 1.850 and 3.400 million bushels as required by the FMP. This alternative would maintain the surfclam quota at the level it was in 2003 (MAFMC 2003a).

**Biological Impacts**

Maintaining the status quo quota for 2004 could possibly affect the long-term growth of the industry, if industry is correct and the demand is growing. There is the argument that the slow growing clams off of Delmarva may need to be thinned in order to be more productive or may never become more productive. (The assessment (USDC 1998a) states: "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.")

**Socioeconomic Impacts**

The socioeconomic impacts of this alternative are discussed in detail in the Regulatory Impact Review (RIR) Sections RIR 7.1.5. and RIR 8.2.2. In sum, this alternative is expected to result in no change in consumer or producer surplus, or in the average gross value of the harvest.

**Essential Fish Habitat Impacts**

The discussion of the preferred alternative details why the Council concluded that clam fishing gear impacts are temporary and minimal. Maintaining the status quo level of quota for 2004 would result in the same minimal level of impacts as occurred in 2003.

**Protected Resources Impacts**

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Clam vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery. Potentially, the less the quota, the less any impact would be.

### 6.1.5 Impacts of Alternative S4 (3.325 million bushels) on the Environment

Splitting the difference between th 2003 quota and the maximum quota allowed under the FMP would produce a quota of 3.325 million bushels and would represent a 2.3% increase above the 2003 quota. The Council assumed none of the surfclam resource on Georges Bank would be available. Given the current condition of the resource this level of quota would not adversely affect the long-term sustainability of the stock. Increased pressure on bottom habitat could possibly cause some minor additional limited adverse effects.

**Biological Impacts**

Given that surfclams are currently not overfished and overfishing is not occurring, this slight increase would not be detrimental.

**Socioeconomic Impacts**

The socioeconomic impacts of this alternative are discussed in detail in the Regulatory Impact Review (RIR) Sections RIR 7.1.6. and RIR 8.2.2. In sum, this alternative is expected to result in an increase in both consumer and producer surplus, and would increase the average gross value of the harvest per allocation holder by $8,824.

**Essential Fish Habitat Impacts**

The discussion of the preferred alternative details why the Council concluded that clam fishing gear impacts are temporary and minimal. Increasing the quota slightly for 2004 would result in at most a slight minimal level of increased impacts.

**Protected Resources Impacts**

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Clam vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery. Potentially, the less the quota, the less any impact would be.

## 6.2 Surfclam Minimum Size Limit Suspension

The Surfclam and Ocean Quahog FMP includes a provision for a minimum size limit of 4.75 inches on surfclams, which may be used to protect new year classes from harvest before they have reached an optimal size. The provision is written such that a minimum size will automatically be in effect unless the Council and NMFS take the active step of suspending it each year.

Regulations for surfclams require that gear restrictions be applied if the proportion of clams smaller than 4.75 inches landed exceeds 30% of the total landings for the entire coast wide stock. Dr. John Witzig in a September 2002 report entitled: *Estimation of Proportion of Landings of*

*Undersized Surfclams for 2002*, identified the data sources and the procedures used in last years evaluation of the size limit suspension. The Witzig report concluded that for January through mid-August 2002, there was only 12 percent of the surfclam landings were smaller than 4.75".

The current stock is comprised primarily of large, adult individuals, with few small individuals apparent from landings in most areas (USDC 2000a). Reinstating a minimum size under these conditions would result in greater harm than benefit, as it would require the industry to use "sorting" machines which will often damage undersized clams as it routes them back overboard.

It is, therefore, the Council's recommendation that the surfclam minimum size limit be suspended for 2004, as has been done every year since 1990. Continuing the suspension will have no impact on the current fishery or resource.

### 6.2.1 Impacts of Preferred Alternative (No action) on the Environment

**Biological Impacts**

There should be no biological impact of the status quo alternative. All clams that are caught are landed resulting in no waste of the resource. The SARC (USDC 2000a) which the Council used in its deliberations considers this resource as under-utilized. The 2003 SARC which was presented to the Council in August does not conflict with the earlier SARC.

**Socioeconomic Impacts**

Maintenance of the status quo alternative would result in no change to the socioeconomic aspects of the surfclam fishery in 2004.

**Essential Fish Habitat Impacts**

Maintenance of the status quo alternative would result in no change to the essential fish habitat impacts from 2003 to 2004. Suspension of the size limit will result in the least amount of any potential gear impact to the ocean bottom.

**Protected Resources Impacts**

Maintenance of the status quo alternative will have no different impacts to any protected resource from 2003 to 2004. Not having a size limit will result in the least amount of overall fishing effort and thus absolutely minimize any potential protected resources impacts.

### 6.2.2 Impacts of Alternative 2 (No suspension) on the Environment

**Biological Impacts**

The Witzig 2002 report identifies that only 12 percent of the landed clams were smaller than 4.75 inches. It is believed that there is no current at sea discards. Survival rates of discarded clams is greater than 50 percent, so even if all the clams smaller than 4.75 inches were discarded, the result would only be about one percent of the annual landings. The 2002 SARC (USDC 2000a) considers this resource as under-utilized and the recently completed SARC considers the resource not overfished with overfishing not occurring.

**Socioeconomic Impacts**

Discarding 12 percent of the landings would increase the cost of harvest and result in longer fishing days and more time at sea for fishermen.

**Essential Fish Habitat Impacts**

Discarding 12 percent of the landings would cause more fishing effort and even though the fishing gear is considered as having only temporary and minimal impacts, there would be more effort required and thus potentially more of an impact.

**Protected Resources Impacts**

Discarding 12 percent of the landings would cause more fishing effort and even though the fishing gear is considered as having only minimal adverse impacts to protected resources, there would be more effort required and thus potentially more of an impact.

## 6.3 Ocean Quahog *Arctica islandica* Quota

### 6.3.1 Impacts of Preferred Alternative Q4 (5.000 million bushels) on the Environment

The Council proposes a 2004 ocean quahog quota of 5.000 million bushels, an 11.1% increase over the quota of the past four years. There is no biological reason that the resource can not support this level of quota given the most recent stock assessments (USDC 1998b and 2000b). The 1997 (4.317 million bushels) and 1998 (4.000 million bushels) reductions were based on evaluation of the harvest level which would satisfy the former Council policy of a harvest level which could be maintained for at least 30 years given the information prior to the 1998 assessment (USDC 1998b). The Council currently bases their recommendations on a harvest policy using MSY. There will be a new stock assessment presented to the SARC in December 2003 for ocean quahogs.

**Summary Justification for Ocean Quahog 5.000 Million Bushel Quota Recommendation**

At its June 2003 meeting on the ocean quahog quota for the coming year, the Mid-Atlantic Council hosted extensive public debate on the issue of whether the quota should be set at 5.000 million bushels, or some other level.

The following points represent the key factors that led the Council to adopt the 5.000 million bushel level for 2004.

> The year 2002 saw a continuation of the renewed interest in the ocean quahog fishery, fueled by the sharp price increase of 2001, and the improved efficiency of newly constructed vessels. Landings had been on a declining trend from the 4.9 million bushel peak in 1992. The 2000 harvest of ocean quahogs was the lowest in two decades, with fully 30% of the Federal quota left unharvested on the ocean floor. In 2001 landings jumped almost 17%, and in 2002 increased another 4.9% to 3.87 million bushels.
>
> A total of 31 vessels participated in the 2002 fishery for ocean quahogs in Federal waters apart from Maine. While this count is an increase of only one vessel over 2001, it includes 4

large vessels that were built since 2000, and their high productivity is likely to increase utilization of the Federal quota substantially.

Of the 4.5 million bushel quota for 2002, approximately 13,300 bushels were leased to the Maine fishery, 3.87 million were harvested by the industrial fishery outside of Maine, and approximately 616,000 bushels were left unharvested on the ocean floor.

The sharp exvessel price increase of 2001 has been largely sustained in 2002. Reported prices generally ranged from $4.50 to $7.00, with a large percentage at either $6.00 or $6.10 per bushel. Verbal reports from industry members indicate that trucking costs, and whether the vessel owner or processor is responsible for paying them, can significantly influence the price paid to a vessel.

Reported hours of fishing effort deployed in the ocean quahog fishery actually decreased by almost 10 percent in 2002. The average number of trips taken per vessel declined from 70 to 64.

A fleet-wide calculation of LPUE showed that average landings increased by 15.6% to 126 bushels per hour fished in 2002 (Table 2). Fully 9.2% of this dramatic increase was attributable to three of the newly constructed vessels. When these vessels are excluded, average LPUE of the remaining 28 vessels was 116 bushels per hour fished, or an increase of 6.4% over 2001.

Harvests of ocean quahogs became more concentrated on the high-yielding degree square off eastern Long Island (4072). Fully 49% of the coastwide quota was taken from this square, which showed an increase in LPUE of 9% to 176 bushels per hour fished. The second most heavily fished degree square is the adjacent square to the east, south of Block Island (4071). It supplied 581,000 bushels in 2002, an increase of 83% over 2001.

Some fishing for ocean quahogs does persist in the southern waters off Delmarva (3873 and 3874). Roughly 15% of the 2002 catch was taken from these waters, though their average catch rates have continued to decline to below 90 bushels per hour fished.

Limits on further movement of the fleet to the east were imposed by the closure of surfclam and ocean quahog beds east of the 69/ line since 1990, due to the presence of PSP toxin. Vessels responded to this barrier by pursuing ocean quahogs in the deeper waters further from shore, however there are indications that only limited quantities of ocean quahogs are available in these areas.

**Biological Impacts**

Based on the biological data presented in the most recent assessments (USDC 1998b and 2000b) the ocean quahog quota could have been increased overall. The Council proposed a 2004 ocean quahog quota based on the analysis of abundance for that species found in the 31st Northeast Regional Stock Assessment Workshop (SAW 31) concluded in August 2000. Similar to surfclams, SAW 31 and the assessment from the 1997 survey (SAW 27) included work to estimate dredge efficiency and showed a significant increase in the estimate of ocean quahog biomass. Although 36 percent of the resource is located on Georges Bank, SAW 31 did not question whether Georges Bank would ever be reopened. It is estimated the even excluding the ocean quahog resource portion on Georges Bank, that fully 82% of the virgin biomass remains after two plus decades of harvesting these long-lived creatures.

The Secretary approved Amendment 12 (MAFMC 1999) with its new overfishing definition in April 1999. The new definition has: a "biomass target" = ½ virgin biomass, "fishing mortality target" = $F_{0.1}$, "biomass threshold" = ½ biomass target, and a "fishing mortality threshold" = to $F_{25\%}$ MSP level yielding F = 0.04. The 1999 quota yielded an F (the last time it was measured at a peer-reviewed SARC) of approximately 0.02 compared to the threshold of 0.04 contained in the overfishing definition. The specific F associated with the 2004 quota is expected to be close to the F in 1999, because a similar proportion of the biomass remains unexploited compared to 1999. Therefore, the proposed quota is below the approved overfishing definition for fishing mortality.

The Amendment 12 overfishing definition for ocean quahogs is MSY based, since 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 (K) of the resource, but well above K/2, where MSY is generally considered to occur. 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 22 of Amendment 13(MAFMC 2003c). 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, 25 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.

In summary, the Council has prevented overfishing of these two resources for the past 25 years and fully intends to continue doing so.

**Socioeconomic Impacts**

The socioeconomic impacts of this alternative are discussed in detail in the Regulatory Impact Review (RIR) Sections RIR 7.2.1., 7.2.2. and RIR 8.2.3. In sum, this alternative is expected to result in an increase in both consumer and producer surplus, and would increase the average gross value of the harvest per allocation holder by $47,619 if the entire quota is harvested.

**Essential Fish Habitat Impacts**

The Sustainable Fisheries Act (SFA) of 1996 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, including what little is known about clam gear impacts to the bottom, were addressed in Amendment 12 (MAFMC 1999) and the new Amendment 13 (MAFMC 2003c). The effect on bottom habitat of the 5.000 million bushel quota would be only slightly more than what is currently occurring and would still be only temporary and minimal impacts.

The discussion of the preferred alternative for surfclams details why the Council concluded that clam fishing gear impacts are temporary and minimal. Increasing the level of quota for 2004 slightly would result in about the same minimal level of impacts as occurred in 2003.

**Protected Resources Impacts**

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Clam vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery. Even with a quota increase of 11%, there should be no interactions/takes of protected resources.

### 6.3.2 Impacts of Alternative Q1 (4.000 million bushels) on the Environment

The minimum quota allowed under the FMP's OY definition is the alternative for 4.000 million bushels, which was not chosen by the Council because it would be constraining to industry and there is no biological reason to constrain industry at this time. The 4.000 million bushel level is the level the Council selected in 1998 and was a reduction of 7.3 percent from 1997. With the 1997 and 1999 surveys and the 1998 and 2000 assessments showing that there is sufficient resource, the Council elected to have a slight increase for 1999 and maintain that level for 2000, 2001, 2002 and 2003.

The quota reductions which the Council recommended in 1997 and 1998 were in part due to questions about the validity of assuming that all of the Georges Bank biomass would become available to the fishery over the course of the 30 year harvest period. In 1996 when the Council made the assumption of a reopening occurring on Georges Bank, the Council stated that additional quota reductions would be necessary in the future if demonstrable progress was not made toward a reopening of Georges Bank in the near future. The 1996 SAW did not provide any forecast for ocean quahogs and only provided the management advice that a 30 - year supply is possible only if the biomass on Georges Bank and in areas off Southern New England and Long Island, generally too deep to be harvested with current technology, were included.

The 1998 and 2000 SAWs (USDC 1998b and 2000b) did not question whether Georges Bank would ever be opened. Fully more than a third of the resource is located on Georges Bank. The resource is of sufficient size overall that the third that is on Georges Bank is not necessary to meet the Council's former 30 supply year policy. This policy has now been replaced with the overfishing definition which is based on MSY and a supply that is sustainable indefinitely.

As with the surfclam resource, the vast majority of ocean quahogs which are left unharvested in 2004 will still be available to the same allocation holders in subsequent years. Earnings are simply deferred rather than lost, with the ocean quahogs being stored in the ocean.

This level of quota may have a slight beneficial effect on the resource since major recruitment incidents have not been identified for the ocean quahog stock, and these animals may take up to 20 years to reach marketable size depending upon environmental conditions. A return to the 1998 quota level may have a slight beneficial effect on the bottom habitat since less bottom would be exposed to the hydraulic dredging, especially in areas that have been heavily fished, however, it has been determined that clam dredge impacts are short-term and minimal.

**Biological Impacts**

The 1998 and 2000 SAWs (USDC 1998b and 2000b) did not question whether Georges Bank would ever be opened. Fully more than a third of the resource is located on Georges Bank. The resource is of sufficient size overall that the third that is on Georges Bank is not necessary to meet the Council's former 30 supply year policy. This policy has now been replaced with the overfishing definition which is based on MSY and a supply that is sustainable indefinitely.

This level of quota may have a slight beneficial effect on the resource since major recruitment incidents have not been identified for the ocean quahog stock, and these animals may take up to 20 years to reach marketable size depending upon environmental conditions.

**Socioeconomic Impacts**

The socioeconomic impacts of this alternative are discussed in detail in the Regulatory Impact Review (RIR) Sections RIR 7.2.1., 7.2.2. and RIR 8.2.3. In sum, the impacts this alternative would have depend largely on whether landings follow historical trends, or the more recent, accelerated trend. If the recent trend holds, then this alternative is expected to result in a significant decrease in both consumer and producer surplus, and would reduce the average gross value of the harvest per allocation holder by $47,619.

**Essential Fish Habitat Impacts**

The discussion of the preferred surfclam alternative details why the Council concluded that clam fishing gear impacts are short-term and minimal. A return to the 1998 quota level may have a slightly higher beneficial effect on the bottom habitat since less bottom would be exposed to the hydraulic dredging, especially in areas that are deeper.

**Protected Resources Impacts**

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Clam vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery. Potentially, the less the quota, the less any impact would be.

### 6.3.3 Impacts of Alternative Q2 (4.250 million bushels) on the Environment

Splitting the difference between the minimum allowable quota under the OY range and the current quota of 4.500 million bushels, yields a quota of 4.250 million bushels. This is a quota reduction of 5.6%. This level was not chosen by the Council because it could be constraining to industry and there is no biological reason to constrain industry at this point. With the 1997 and 1999 surveys and 1998 and 2000 assessments showing that there is sufficient resource, the Council elected to have a slight increase for 1999, and maintain that level for 2000, 2001, 2002, and 2003, in order to allow the industry to slightly grow.

The quota reductions which the Council recommended in 1997 and 1998 were in part due to questions about the validity of assuming that all of the Georges Bank biomass would become available to the fishery over the course of the 30 year harvest period. In 1996 when the Council made the assumption of a reopening occurring on Georges Bank, the Council stated that additional quota reductions would be necessary in the future if demonstrable progress was not made toward a reopening of Georges Bank in the near future. The 1996 SAW did not provide any forecast for ocean quahogs and only provided the management advice that a 30 - year supply is possible only if the biomass on Georges Bank and in areas off Southern New England and Long Island, generally too deep to be harvested with current technology, are included.

**<u>Biological Impacts</u>**

The 1998 and 2000 SAWs (USDC 1998b and 2000b) did not question whether Georges Bank would be opened. Fully a third of the resource is located on Georges Bank. The resource is of sufficient size overall that the third that is on Georges Bank is not necessary to meet the Council’s former 30 supply year policy, which has been replaced by the overfishing definition.

As with the surfclam resource, the vast majority of ocean quahogs which are left unharvested in 2004 will still be available to the same allocation holders in subsequent years. Earnings are simply deferred rather than lost, with the ocean quahogs being stored in the ocean rather than in refrigerated containers or cans.

This level of quota may have a slight beneficial effect on the resource since major recruitment incidents have not been identified for the ocean quahog stock, and these animals may take up to 20 years to reach marketable size depending upon environmental conditions.

**<u>Socioeconomic Impacts</u>**

The socioeconomic impacts of this alternative are discussed in detail in the Regulatory Impact Review (RIR) Sections RIR 7.2.1., 7.2.2. and RIR 8.2.3. In sum, the impacts this alternative would have depend largely on whether landings follow historical trends, or the more recent, accelerated trend. If the recent trend holds, then this alternative is expected to result in a decrease in both consumer and producer surplus, and would reduce the average gross value of the harvest per allocation holder by $23,810.

**<u>Essential Fish Habitat Impacts</u>**

The discussion of the preferred surfclam alternative details why the Council concluded that clam fishing gear impacts are temporary and minimal. A reduction of the current quota level may have a slightly higher beneficial effect on the bottom habitat since less bottom would be exposed to the hydraulic dredging, especially in areas that are deeper.

**Protected Resources Impacts**

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Clam vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery. Potentially, the less the quota, the less any impact would be.

### 6.3.4 Impacts of Alternative Q3 (4.500 million bushels) on the Environment (No action)

This is the current quota and 500,000 bushels above the minimum of the OY range for ocean quahog quotas. Bottom habitat may be slightly less negatively impacted as fewer ocean quahogs would be removed. Exvessel prices may likely rise as supply may become constraining. For 1999, industry requested the Council raise the quota to 4.500 million bushels as that is what they expected to be able to sell in 1999 and, in general, they have supported maintaining the status quo for 2000, 2001, 2002, and 2003, but now believe that a quota increase is necessary.

**Biological Impacts**

Given the current state of the stock, that the ocean quahog resource is "not overfished and overfishing is not occurring", a slight increase in quota would not be at all harmful.

**Socioeconomic Impacts**

The socioeconomic impacts of this alternative are discussed in detail in the Regulatory Impact Review (RIR) Sections RIR 7.2.1., 7.2.2. and RIR 8.2.3. In sum, the impacts of this status quo alternative would remain the same.

**Essential Fish Habitat Impacts**

The discussion of the preferred surfclam alternative details why the Council concluded that clam fishing gear impacts are temporary and minimal. Maintaining the current quota level would have the same impact on the bottom habitat since the same amount of bottom would be exposed to the hydraulic dredging.

**Protected Resources Impacts**

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Clam vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery. Potentially, the less the quota, the less any impact would be.

### 6.3.5 Impacts of Alternative Q5 (6.000 million bushels) on the Environment

This is the maximum of the FMP's OY range for ocean quahog quotas and would be a quota increase of 33.3% above the status quo. Bottom habitat could potentially be negatively impacted as roughly 33.3% more ocean quahogs would be removed. Exvessel prices likely would fall as supply would greatly exceed demand. For 1999, industry requested the Council raise the quota to 4.5 million bushels as that is what they expected to be able to sell in 1999 and they supported maintaining the status quo for 2000, 2001, 2002 and 2003, but believe a slight quota increase to 5 million bushels will be needed in 2004.

**Biological Impacts**

This large of an increase in one year could have some slight biological impact. Annual fishing mortality would likely go from 2% to near 3% and thus would be between the target and threshold level of overfishing.

**Socioeconomic Impacts**

The socioeconomic impacts of this alternative are discussed in detail in the Regulatory Impact Review (RIR) Sections RIR 7.2.1., 7.2.2. and RIR 8.2.3. In sum, the impacts this alternative would have depend largely on whether landings follow historical trends, or the more recent, accelerated trend. If the recent trend holds, then this alternative is expected to result in a significant increase in both consumer and producer surplus, and could increase the average gross value of the harvest per allocation holder by as much as $142,857.

Note that it is very unlikely industry would be able to increase harvests by such a large amount in a single year.

**Essential Fish Habitat Impacts**

The discussion of the preferred surfclam alternative details why the Council concluded that clam fishing gear impacts are temporary and minimal. A 33.3% increase of the current quota level may have a slightly higher impact on the bottom habitat since more bottom would be exposed to the hydraulic dredging.

**Protected Resources Impacts**

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Clam vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery. Potentially, the more the quota, the more the fishing, the slightly more the minimal adverse impacts realized.

## 6.4 Maine Ocean Quahog *Arctica islandica* Quota

Three alternative quotas are presented for the Maine ocean quahog fishery. Alternative M3 would maintain the status quo quota at the maximum allowable level of 100,000 Maine bushels.

### 6.4.1 Impacts of Preferred Alternative (100,000 bushels) on the Environment (No action)

The Council recommends that the Maine ocean quahog quota for 2004 remain unchanged at the initial maximum quota of 100,000 Maine bushels (1 bushel = 1.2445 cubic feet).

The Council believes that the 2003 quota will likely be reached and the Regional Administrator will close the fishery in 2003 as she had to do in 2000 and 2002. It is anticipated that the Regional Administrator will likely also have to close the fishery in 2004. The Maine fishery was not closed in 2001 because of the quota being reached but was closed for nearly a month in the summer due to PSP. It is likely that this PSP closure during the peak of the season precluded a closure attributable to exceeding the annual quota.

According to 50 CFR section 648.76 (2)(b)(iv): *The Regional Administrator will monitor the quota based on dealer reports and other available information and shall determine the date when the quota will be harvested. NMFS shall publish notification in the Federal Register advising the public that, effective upon a specific date, the Maine mahogany quahog quota has been harvested and notifying vessel and dealer permit holders that no Maine mahogany quahog quota is available for the remainder of the year.*

It must also be remembered that according to 50 CFR section 648.76 (2)(b)(iii): *All mahogany quahogs landed by vessels fishing in the Maine mahogany quahog zone for an individual allocation of quahogs under section 648,70 will be counted against the ocean quahog allocation for which the vessel is fishing.* In other words, even after the initial maximum quota of 100,000 Maine bushels is harvested from the Maine mahogany ocean quahog zone (north of $43^{o}50^{'}$), vessels could obtain/use ITQ allocation and continue to fish in this zone. It is anticipated that some Maine fishermen will again rent ITQ allocation after the 100,000 bushel quota is reached in 2002 and 2004 as they have done for the past two years. More than half (4,530 bushels) of the 8,500 bushels that were above the 100,000 quota in 2001 were landed with an ITQ allocation. In 2000, there were 5,821 bushels landed with ITQ shares of the 20,767 bushels that exceeded the 100,000 bushel quota. There were no quota overages prior to 2000. Since implementation of Amendment 10 in 1998, approximately 70 % of the average annual landings have been reported as coming from state waters and 30% from Federal waters.

Amendment 10 (MAFMC 1998) emphasized that there had been no comprehensive, systematic survey or assessment of the ocean quahog resource in eastern Maine. It also emphasized that a full stock assessment of the Maine resource should be a priority to ensure that this segment of the fishery would have a sustainable future. The initial maximum quota for the Maine zone was to remain in effect until a resource survey and assessment was completed. The agreement at the time of Amendment 10 was that the State of Maine was to initiate a survey once the initial maximum quota of 100,000 bushels became constraining. There is an effort within the State of Maine to initiate an ocean quahog survey in 2002. Scott Feindel has been hired and is currently working with a commercial fishermen to survey the distribution of the resource along the Maine coast.

**Biological Impacts**

There should be no change in the biological impacts of maintaining the status quo quota for 2004. Although the condition of the Maine ocean quahog is currently unknown, the ocean quahog fishery overall is not overfished and overfishing is not occurring. It is planned that surveys will be conducted in 2002 and 2003 with an assessment in December 2003, and thus quotas specifically for the Maine stock of ocean quahogs will be able to be based on sound science beginning with the 2005 harvests.

**Socioeconomic Impacts**

The socioeconomic impacts of this alternative are discussed in detail in the Regulatory Impact Review (RIR) Sections RIR 7.2.3. and RIR 8.2.4. In sum, this alternative is expected to result in no change in consumer or producer surplus, or in the average gross value of the harvest.

**Essential Fish Habitat Impacts**

The discussion of the preferred surfclam alternative details why the Council concluded that clam fishing gear impacts are temporary and minimal. Maintaining the current quota level will not change the impact on the bottom habitat since no more bottom would be exposed to the dredging.

**Protected Resources Impacts**

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Clam vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery. Maintaining the current status quo will not change this minimal impact.

**6.4.2 Impacts of Alternative M1 (50,000 bushels) on the Environment**

Alternative M1 corresponds to a 50% reduction from the maximum allowable quota under the current management plan. There is no real justification to the halving of the current quota.

**Biological Impacts**

It is unknown if a halving of the quota would change the biological impacts for 2004. The impacts of any quota are unknown since no survey and assessment have been conducted on this segment of the ocean quahog resource. It is planned that surveys will be conducted in 2002 and 2003 with an assessment in December 2003.

**Socioeconomic Impacts**

The socioeconomic impacts of this alternative are discussed in detail in the Regulatory Impact Review (RIR) Sections RIR 7.2.3. and RIR 8.2.4. In sum, this alternative is expected to result in a slight decrease in both consumer and producer surplus, and would increase harvest costs to vessels by an average of $1,286.

**Essential Fish Habitat Impacts**

The discussion of the preferred surfclam alternative details why the Council concluded that clam fishing gear impacts are temporary and minimal. Halving the current quota level may reduce any impact on the bottom habitat since less bottom would be exposed to the dredging.

**Protected Resources Impacts**

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Clam vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery. Potentially, the less the quota, the less any impact would be.

### 6.4.3 Impacts of Alternative M2 (84,700 bushels) on the Environment

Alternative M2 corresponds to the maximum harvest level minus the 2002 overage and would reduce the allowable harvest by 18%. There is no real justification in the FMP or the regulations to subtract one year's overage from the next years's level of harvest. These Maine fishermen have worked hard to build a market and a stock assessment for this portion of the resource should be available in a few years.

**Biological Impacts**

It is unknown if reducing the quota would change the biological impacts for 2004. The impacts of any quota are unknown since no survey and assessment have been conducted on this segment of the ocean quahog resource. It is planned that surveys will be conducted in 2002 and 2003 with an assessment in December 2003.

**Socioeconomic Impacts**

The socioeconomic impacts of this alternative are discussed in detail in the Regulatory Impact Review (RIR) Sections RIR 7.2.3. and RIR 8.2.4. In sum, this alternative is expected to result in no change in consumer surplus, and a slight decrease in producer surplus. It is estimated that harvest costs to would increase by an average of $393 per vessel.

**Essential Fish Habitat Impacts**

The discussion of the preferred surfclam alternative details why the Council concluded that clam fishing gear impacts are temporary and minimal. Reducing the current quota level may reduce any impact on the bottom habitat since less bottom would be exposed to the dredging.

**Protected Resources Impacts**

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Clam vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery. Potentially, the less the quota, the less any impact would be.

## 6.5 Research Set Aside

There is no research set aside for either of these species. Industry works very well with the NEFSC, academics and managers to obtain the necessary science and information.

## 6.6 Cumulative Impacts of Preferred Alternative

A cumulative impact analysis is required by the Council on Environmental Quality's (CEQ) regulation for implementation of NEPA. Cumulative effects are defined under NEPA as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other action (40 CFR section 1508.7)." A formal cumulative impact assessment is not necessarily required as part of an Environmental Assessment under NEPA as long as the significance of cumulative impacts has been considered (U.S. EPA 1999). The following remarks address the significance of the expected cumulative impacts as they relate to the Federally managed surfclam and ocean quahog fisheries.

The cumulative impacts of past, present, and future Federal fishery management actions (including the specification recommendations proposed in this document) should generally be positive. Although past fishery management actions to conserve and protect fisheries resources and habitats may have been more timely, the mandates of the MSFCMA as currently amended by the SFA require the management actions be taken only after consideration of impacts to the biological, physical, economic, and social dimensions of the human environment. It is, therefore, expected that under the current management regime, the totality of Federal fisheries management impacts to the environment will, in general, contribute toward improving the human environment.

Cumulative effects to the physical and biological dimensions of the environment may also come from non-fishing activities. Non-fishing activities, in this sense, relate to habitat loss from human interaction and alteration or natural disturbances. These activities are widespread and can have localized impacts to habitat such as accretion of sediments from at-sea disposal areas, oil and mineral resource exploration, and significant storm events. In addition to guidelines mandated by the MSFMCA, NMFS reviews these types of effects during the review process required by Section 404 of the Clean water Act and Section 10 of the Rivers and Harbors Act for certain activities that are regulated by Federal, state, and local authority. The jurisdiction of these activities is in "waters of the United States" and includes both riverine and marine habitats. A database which could facilitate documentation regarding cumulative impacts of non-fishing activities on the physical and biological habitat covered by the surfclam and ocean quahog management unit is not available at this time. The development of a habitat and effect database would accelerate the review process and outline areas of increased disturbance. Inter-agency coordination would also prove beneficial.

Effective fishery management by the Council and NMFS of surfclams and ocean quahogs has occurred since 1977. This was the first fishery management plan in the country under the Fishery Conservation and Management Act of 1976. The surfclam resource had been grossly overfished prior to management and within a few years after implementation of management measures was rebuilt and sustaining healthy fisheries. The two resources have always had reasonable quotas (initially based on MSY estimates that were derived using the best science available at the time) which have prevented overfishing. Secondary effort restrictions to allow year round harvest became rather draconian on the fishermen during the 1980s. Implementation of the ITQ program in 1990 allowed fishermen much more flexibility and improved safety.

The cumulative impacts of this FMP were last fully addressed in the EIS for Amendment 8 (MAFMC 1990) and are currently fully addressed in the draft Amendment 13 which is in for Secretarial review. Both species in the management unit are managed primarily via annual quotas to control fishing mortality. This FMP requires a specifications process which allows for the review and modifications to management measures specified in the FMP on an annual basis which allows for review. In addition, the Council added a framework adjustment procedure in Amendment 12 (MAFMC 1999) which allows the Council to add or modify management measures through a streamlined public review process. As noted above, the cumulative impact of this FMP and annual specification process has been positive since its implementation after passage of the Magnuson Act. Neither species has been overfished since the rebuilding of surfclams after the initial management.

Through development of the FMP and the subsequent annual specification process, the Council continues to manage these resources in accordance with the National Standards required under the Magnuson-Stevens Act. First and foremost the Council has met the obligations of National Standard 1 by adopting and implementing conservation and management measures that have prevented overfishing, while achieving, on a continuing basis, the optimum yield for the two species and the United States fishing industry. The Council uses the best scientific information available (National Standard 2) and manages these two resources throughout their range (National Standard 3). The management measures do not discriminate between residents of different states (National Standard 4), they do not have economic allocation as its sole purpose (National Standard 5), the measures account for variations in fisheries (National Standard 6), avoid unnecessary duplication (National Standard 7), they take into account the fishing communities (National Standard 8) and promote safety at sea (National Standard 10). Finally, National Standard 9 addresses bycatch in fisheries and these fisheries are extremely clean fisheries by their nature. Amendment 13 (MAFMC 2003c) fully addresses how the management measures implemented to successfully manage these two species comply with the National Standards. Amendment 13 also addresses the fishing gear impacts to essential fish habitat which is also positive, partly because of the implementation of ITQs in 1990, but also attributable to successful management during the past 25 years.

By continuing to meet the National Standards requirements of the Magnuson-Stevens Act through future FMP Amendments and actions, the Council will insure that cumulative impacts of these actions will remain overwhelmingly positive for the ports and communities that depend on these fisheries, the Nation as a whole, and certainly for the resources.

The cumulative effects of the proposed quotas will be examined for the following five areas: targeted species, non-targeted species, protected species, habitat, and communities.

**Targeted species**

First and foremost with these two species, the Council has met the obligations of National Standard 1 by adopting and implementing conservation and management measures that have prevented overfishing, while achieving, on a continuing basis, the optimum yield for the two species and the United States fishing industry. Surfclams were overfished prior to management and subsequently rebuilt. Ocean quahogs have never been overfished. Both surfclams and ocean quahogs are in-sediment living animals and are not vulnerable to other types of fishing gear (i.e., they are not captured by otter trawls, pelagic trawls, gill nets or harpoons). Both species are caught by hydraulic clam dredges for the industrial fisheries or by dry dredges in the small artisanal fishery in Maine.

The Council manages these two species only in the EEZ with the exception of the Maine artisanal fishery which occurs in both Federal and state waters. Any zoning type activities in the EEZ that did not consider these two species could impact their populations locally. The Council has commented on anthropogenic projects such as beach replenishment and ocean dumping in the past while raising concerns for the local health of surfclams and ocean quahogs. Since these two species occur over wide areas of the mid and north Atlantic, it is unlikely that any anthropogenic activity could currently significantly impact either population on more than simply a local level.

None of the proposed quotas or suspension of the surfclam minimum size limit would have any significant effect on the target species by itself, or in conjunction with other anthropogenic activities.

**Non-target species or bycatch**

National Standard 9 addresses bycatch in fisheries and these surfclam and ocean quahog fisheries are extremely clean fisheries by their nature. 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 specification package will promote or result in increased levels of bycatch relative to the no action. 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 34 of Amendment 13, MAFMC 2003c). 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. Commercial operations are certainly even cleaner than the scientific surveys which have liners in the dredges, as all animate and inanimate objects except for surfclams and ocean quahogs are discarded quickly before the resource is placed in the cages. The processors reduce their payments if "things" other than surfclams or ocean quahogs are in the cages.

Commercial clam dredging vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. 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. Bycatch in the 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.).

Relative to the new approach to fisheries management that is being discussed extensively, ecosystem management, a recent paper by Arnason (1998) suggests that an ITQs system offers a potentially fruitful approach to the problem of ecological fisheries management. All fish stocks and their associated fisheries are embedded in an ecosystem. Therefore, to obtain maximum economic benefits, fisheries management must take due account of the corresponding web of ecological interrelationships. Unfortunately, due to the inherent complexity of ecosystems and the scarcity of the relevant empirical information, sensible ecological fisheries management is very difficult to achieve in most cases. According to Arnason (1998) the great advantage of the ITQ regime is that it enlists market forces to bring about the optimal utilization of the ecology.

Of course, bycatch in one fishery is another fishery's target. Many fisheries have collapsed their targeted resource and required extensive rebuilding periods. New England groundfish are a present case example of management decisions/indecisions which have allowed the continued overcapitalization of the fisheries and depletion of the resources, both from targeting and non selective fishing practices. The 1996 amendments to the Act have contributed greatly to efforts to rebuild the overfished resources and thus many of the resources that were bycatch problems will be rebuilt in the future.

None of the proposed quotas or suspension of the surfclam minimum size limit would have any effect on non targeted species by itself, or in conjunction with other anthropogenic activities, other than other fisheries which are out of the control of this FMP. An ITQ program, as in these fisheries, reduces the "race to fish" and therefore reduces bycatch of undesirable species.

### Protected resources

There are numerous species which inhabit the environment within the management unit of this FMP that are afforded protection under the Endangered Species Act (ESA) of 1973 (i.e., for those designated as threatened or endangered) and/or the Marine Mammal Protection Act of 1972 (MMPA). Eleven are classified as endangered or threatened under the ESA, while the remainder are protected by the provisions of the MMPA. The Council examined the list (section 4,2) of species protected either by the Endangered Species Act of 1973 (ESA), the Marine Mammal Protection Act of 1972 (MMPA), or the Migratory Bird Act of 1918 that may be found in the environment utilized by Atlantic surfclam and ocean quahog fisheries.

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 118 of the Marine Mammal Protection Act (MMPA) of 1972. In addition, the proposed actions will not significantly increase fishing effort. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery.

The range of surfclams, ocean quahogs, and the above marine mammals and endangered species overlap 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 abundances. The Council believes that implementation of these quotas will have no adverse impact upon these populations. While marine mammals and endangered species may occur near surfclam and ocean quahogs beds, it is highly unlikely any significant conflict between the fishermen managed by this FMP and these species would occur. Clam 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 mostly pelagic and spend nearly all of their time up in the water column or near the surface as do, of course, seabirds.

None of the proposed quotas or suspension of the surfclam minimum size limit will have any effect on protected resources by this fishery. Of course, interactions of protected resources with other fisheries and marine traffic can have a significant effect to several of these protected resource populations, however the fisheries for surfclams and ocean quahogs should not contribute to these cumulative effects. An ITQ program, as in these fisheries, reduces the "race to fish" and therefore also contributes to the care and protection by fishermen of the overall marine environment.

**Habitat**

The Council concluded from the fishing gear impacts workshop (Appendix 4 of Amendment 13) that there is sufficient information that clam dredges could have an effect on EFH if the gear is fished improperly or in the wrong sediment type. For example, hydraulic clam dredges would have a significant impact to a coral reef or an SAV bed if such gear were used in a stable, fragile, structured, environment like one of those environments. However, the clam resources are concentrated in high energy sandy sediment and the fishing gear has evolved over the past five decades to fish most efficiently in this type of sandy sediment. This evolution of the fishing gear has minimized the effect on fishery habitat (Wallace and Hoff in press). Natural events have more effect on the benthic community than this type of fishing gear since all of the fishing activity takes place in sandy shallow water. Chiarella *et al.* (2002) describing the October 2001 fishing gear impacts workshop concluded that hydraulic clam dredges were not a major concern relative to otter trawls and scallop dredges. All of the hydraulic clam dredging for an entire year, would impact about 100 square miles of bottom (Table 2 of MAFMC 2003c). In context, this 100 square miles is roughly the area of one and a half ten minute square, and there are over 1200 ten minute squares in the EEZ between Cape Hatteras and Georges Bank. Thus, it does not appear that either surfclam or ocean quahog EFH is effected by fishing gear.

A qualitative EFH vulnerability analysis conducted by Stevenson *et al.* (2003) suggests that the EFH of several species may be vulnerable to impacts associated with the use of hydraulic clam dredges. This includes black sea bass (juveniles and adults), scup (juveniles), ocean pout (all life stages), red hake (juveniles), silver hake (juveniles), winter flounder (juveniles and adults), and Atlantic sea scallops (section 2.2.5.5.2 of MAFMC 2003c).

Based upon existing information the Council concluded that there may be potential adverse effects on EFH from the hydraulic clam dredge, but concurred with the fishing gear impacts workshop panel (Appendix 4of MAFMC 2003c). The panel concluded that as the clam fishery is currently prosecuted, in sand habitats, there are potentially large, localized impacts to biological and physical structure, however the recovery time is relatively short. Since the recovery time is relatively short (hours to months) the adverse impacts to this high energy environment can be considered temporary. The preamble to the EFH Final Rule (50 CFR Part 600) defines temporary impacts as those that are limited in duration and that allow the particular environment to recover without measurable impact. Since these impacts are potentially effecting a relatively small portion (approximately 100 square nautical miles) of the overall large uniform area of high energy sand along the continental shelf (approximately 54,900 square nautical miles) these adverse impacts can be considered minimal. Additionally, the 100 square nautical miles impact each year (approximately 1.5 ten minute squares of latitude and longitude) represents a small fraction of the total EFH of the above listed vulnerable EFH and species. The preamble of the EFH Final Rule defines minimal impacts as those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions.

This NEPA analysis is detailed in section 7 (Essential Fish Habitat Assessment) of this EA, based on the conclusions that the impacts are temporary and minimal. The Council has concluded that any small quota increase minimizes, to the extent practicable, the adverse effects of fishing on EFH as required by section 303 (a) (7) of the MSA.

No other fishing gear (otter trawls, scallop dredges, gill nets, etc.) is known to effect surfclam or ocean quahog EFH. The Council manages these two species only in the EEZ with the exception of the Maine artisanal fishery which occurs in both Federal and state waters. Any zoning type activities in the EEZ that did not consider these two species could impact their populations locally. The Council has commented on anthropogenic projects such as beach replenishment and ocean dumping in the past while raising concerns for the local health of surfclams and ocean quahogs. Since these two species occur over wide areas of the mid and north Atlantic, it is unlikely that any anthropogenic activity could currently significantly impact either population on more than simply a local level.

None of the proposed quotas or suspension of the surfclam minimum size limit would have any significant effect on the essential fish habitat for surfclams or ocean quahogs by itself, or in conjunction with other anthropogenic activities.

**Communities**

National Standard 8 requires that management measures take into account the fishing communities. For Amendment 13 (MAFMC 2003c) to this FMP, the Council hired Dr Bonnie McCay and her associates from Rutgers University to describe the ports and communities that are associated with the surfclam and ocean quahog fisheries. Communities from Maine to Virginia are involved in the harvesting and processing of surfclams and ocean quahogs (section 4.2).

The ports and communities involved in these fisheries will positively benefit from the increases in surfclam and ocean quahog quotas and the suspension of the surfclam minimum size limit. With regard to the specific quota recommendations proposed in this document, impact to the affected biological and physical and human environment are described in section 6. Given that no negative impacts are anticipated to result from the preferred alternatives, the synergistic interaction of improvements in the efficiency of the fishery are expected to generate positive impacts overall. These impacts will be felt most strongly in the social and economic dimension of the environment. Direct economic and social benefit from improved fishery efficiency is most likely to affect participants in the harvesting and processing sectors of the surfclam and ocean quahog fisheries. These benefits are addressed in the RIR/IRFA of this document. Indirect benefits of the preferred alternatives are likely to affect consumers and the areas of economic and social environment that interact in various ways with these fisheries.

The proposed actions, together with past and future actions are expected to result in positive cumulative impacts on the biological, physical, and human components of the environment. These fisheries have been well managed for the past twenty five years and especially since ITQ implementation in 1990. The resources are healthy and the fisheries are sound. As long as management continues to prevent overfishing and prevent the "race to fish", the fisheries and their associated communities will prosper.

# 7.0 ESSENTIAL FISH HABITAT ASSESSMENT

## 7.1 Introduction

This Essential Fish Habitat (EFH) Assessment is provided pursuant to 50 CFR 600of the Essential Fish Habitat Final Rule of January 17, 2002 for the Council to initiate EFH consultation with the National Marine Fisheries Service.

Surfclams and ocean quahogs have EFH designated in many of the same bottom habitats that have been designated as EFH for most of the MAFMC managed species of summer flounder/scup/black sea bass, squid/mackerel/butterfish, bluefish, tilefish, and dogfish, as well as the NEFMC species of groundfish within the Northeast Multispecies FMP, including: Atlantic cod, haddock, monkfish, ocean pout, American plaice, pollock, redfish, white hake, windowpane flounder, winter flounder, witch flounder, yellowtail flounder, Atlantic halibut and Atlantic sea scallops. Numerous species within the NMFS Highly Migratory Species Division and the SAFMC have EFH identified in areas also identified as EFH for surfclams and ocean quahogs. Broadly, EFH is designated as the bottom habitats within the Gulf of Maine, Georges Bank, and the continental shelf off southern New England and the mid-Atlantic south to Cape Hatteras for the juveniles and adults of these two species.

### 7.2. Description and Identification of Essential Fish Habitat

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 (Appendices 5 and 6) are considered the best scientific information available for EFH in order to meet National Standard 2 of the MSFCMA.

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 Amendment 13 as Tables 11and 12.

Amendment 12 (MAFMC 1999) identified and described essential fish habitat for surfclams and ocean quahogs in section 2.2.2. No new information exists that would provide the basis for changing the EFH identification and description that was developed in Amendment 12.

#### 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 (Figures 30 and 31of Amendment 13). 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 (Figures 32 and 33 of Amendment 13). 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 $^{o}$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 identified in Amendment 12 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.

### 7.3 Identification of Habitat Areas of Particular Concern

According to section 600.815 (a)(8), 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 did not recommend any portions of EFH as HAPC for surfclams or ocean quahogs in Amendment 12 and has no new information to warrant a change 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 (Appendices 5 and 6 of Amendment 13). The information in the EFH background documents appear inadequate at this time to put a high priority on any specific habitat.

### 7.4 Fishing Activities that May Adversely Affect EFH

#### 7.4.1 Statutory requirements

The 2002 final rule for EFH requires that fishery management plans minimize to the extent practicable adverse effects on essential fish habitat caused by fishing (section 600.815 (a) (2)). Pursuant to the final EFH regulations (50 CFR 600.815(a)(2)), FMPs must contain an evaluation of the potential adverse effects of fishing on EFH designated under the FMP, including effects of each fishing activity regulated under the FMP or other Federal FMPs. The evaluation should consider the effects of each fishing activity on each type of habitat found within EFH. FMPs must describe each fishing activity, review and discuss all available relevant information (such as information regarding the intensity, extent, and frequency of any adverse effect on EFH: the type of habitat within EFH that may be affected adversely; and the habitat functions that may be disturbed), and provide conclusions regarding whether and how each fishing activity adversely affects EFH. The evaluation should also consider the cumulative effects of multiple fishing activities on EFH. The evaluation should list any past management actions that minimize potential adverse effects on EFH and describe the benefits of those actions to EFH. The evaluation should give special attention to adverse effects on habitat areas of particular concern and should identify for possible designation as habitat areas of particular concern any EFH that is particularly vulnerable to fishing activities. Additionally, the evaluation should consider the establishment of research closure areas or other measures to evaluate the impacts of fishing activities on EFH. In completing this evaluation, Councils should use the best scientific information available, as well as other appropriate information sources. Councils should consider different types of information according to its scientific vigor.

In order to meet the above mandates, NMFS (Appendix 3 of Amendment 13) developed a report which summarizes available information concerning impacts of fishing on marine habitats in the Northeast region of the United States (North Carolina – Maine). Some of the studies that are cited were conducted in the Northeast region, while others were conducted in other locations in the United States or in other countries. Information sources include peer reviewed scientific journals, as well as non peer-reviewed reports. Major bibliographic sources include Rester (2000), NMFS Alaska Fisheries Science Center bibliography (Wion and McConnaughey 2000), and numerous ICES reports. In addition, a thorough literature search was completed to ensure inclusion of recent articles.

Research results are presented in Appendix 3 of Amendment 13 by gear type for three major gear categories: bottom-tending mobile gear, bottom-tending static gear, and mobile and static pelagic gear. Sixty different gear types were considered in this report. In addition to summarizing research results, the report also includes a description of each gear type, information on the spatial distribution of fishing activity for 17 individual gears used in the Northeast region during 1995 – 2000, and, where appropriate, summaries of the management implications of research. An attempt was made to identify the sediment type (e.g., mud, sand, hard bottom) and location of each study. No attempt was made in the report to draw any conclusions concerning the habitat impacts of any type of fishing gear. Any conclusions that appear in the report are those reached by the authors of the research that are summarized in the report.

### 7.4.2 Information needs and research approaches

The NMFS (USDC 2001) report entitled *The Effects of Fishing on Marine Habitats of the Northeastern United States* (Appendix 3 of Amendment 13) addresses the information that is needed to assess habitat impacts as well as the research approaches used. The Council concurs with those sections identified by NMFS in the report.

### 7.4.3 Generalized fishing gear effects

A number of scientific reviews summarize existing information on the effects of fishing gear to habitat (McAllister 1991, ICES 1992, Jennings and Kaiser 1998, Auster and Langton 1999, Blaber *et al.* 2000, Collie *et al.* 2000a). Within these reviews, types of effects fall into specific categories, including alteration of physical structure, sediment suspension, chemical changes, benthic community changes, and ecosystem changes. These effects are discussed below.

#### 7.4.3.1 Alteration of physical structure

Physical effects of fishing gear can include scraping, ploughing, burial of mounds, smoothing of sand ripples, removal of stones or dragging and turning of boulders, removal of taxa that produce structure, and removal or shredding of submerged aquatic vegetation ( Fonseca *et al*. 1984, Messieh *et al.* 1991, Black and Parry 1994, Gordon *et al.* 1998, Kaiser *et al.* 1998, Lindeboom and deGroot 1998, Schwinghamer *et al.* 1998, Auster and Langton 1999, Kaiser *et al.* 1999, Ardizzone *et al.* 2000). These physical alterations reduce the heterogeneity of the sediment surface, alter the texture of the sediments, and reduce the structure available to biota as habitat.

As mobile gear is dragged across the seafloor, parts of the gear can penetrate up to 2 to 12 inches into the substrate under usual fishing conditions, and likely to greater depths under unusual conditions (Drew and Larsen 1994).

Direct effects on the seafloor are evident in tracks left by mobile gear that can endure for up to 16 hours in hard sand sediments or for as long as 5 years in soft sediments (Thompson 1993). Effects on hard substrates, such as coral reefs, can persist much longer. Within these tracks, large percentages of emergent epifauna, such as sponges, corals or gorgonians, are often removed, crushed, or broken (Van Dolah *et al.* 1987, Behnken 1994).

A number of review papers have focused specifically on the physical effects of bottom trawls. According to an ICES working report (1973), otter trawls, beam trawls and dredges are all similar in their types of impacts on the seabed, but the magnitude of impact increases from shrimp to sole beam trawls with tickler and stone guards, to Rapido trawl, to mollusc dredge. Moran and Stephenson (2000) conclude that semi-pelagic trawls towed above the seafloor inflict less damage/mortality on benthos, but result in lower catches of target fishes and that the light trawl gear currently in use in northwest Australia results in less mortality (15.5% vs. 89% documented by Sainsbury *et al.* 1997) than heavy gear used in the past. This statement should be evaluated for trawl gear used in U.S. fisheries (Appendix 3 of Amendment 13).

### 7.4.3.2 Sediment suspension

Resuspension of sediments occurs as fishing gear is dragged along the seafloor. Effects of sediment suspension can include reduction of light available for photosynthetic organisms, burying benthic biota, smothering of spawning areas, and negative effects on feeding and metabolic rates of organisms. If resuspension occurs over a large enough area it can actually cause large scale redistribution of sediments (Messieh *et al.* 1991, Black and Parry 1994). Resuspension can also have important implications for regional nutrient budgets due to burial of fresh organic matter and exposure of deep anaerobic sediment, upward flux of dissolved nutrients in pore water, and change in metabolism of benthic infauna.

Effects of sediment resuspension are site-specific and depend on sediment grain size and type, hydrological conditions, faunal influences, and water mass size and configuration (Hayes *et al.* 1984, LaSalle 1990, Barnes *et al.* 1991, Coen 1995). Effects are likely more significant in waters that are normally clear compared with areas that are already highly perturbed by physical forces (Kaiser 2000). Schoellhamer (1996) concluded that resuspension by natural mechanisms in a shallow estuary in west-central Florida was less frequent and of smaller magnitude than anthropogenic mechanisms (i.e., fishing) and that sediments disturbed by fishing were more susceptible to resuspension by tidal currents. Modeling by Churchill (1989) concluded that resuspension by trawling is the primary source of suspended sediment over the outer continental shelf, where storm-related stresses are weak. In the Kategat Sea, Sweden, sandy sediments above the halocline were more affected by wind induced impacts than by fishing effort, but mud sediments below the halocline experienced an increase in the frequency of disturbance by 90% in the spring and summer and by 75-85% in the autumn and winter due to fishing (Floderus and Pihil 1990). Thus, even when recovery times are fast, persistent disturbance by fishing could lead to cumulative impacts. In contrast, Dyekjaer *et al.* (1995) found that in Denmark, although local effects of short duration might occur, annual release of suspended particles by mobile fishing gear is relatively unimportant compared with that resulting from wind and land runoff.

Chronic suspension of sediments and resulting turbidity can also affect aquatic organisms through behavioral, sublethal and lethal effects, depending on exposure. Species reaction to turbidity depends on life history characteristics of the species. Mobile organisms can move out of the affected area and quickly return once the disturbance dissipates (Simenstad 1990, Coen 1995). Even if species experience high mortality within the affected area, species with short life history stages and high levels of recruitment or high mobility can repopulate the affected area quickly. However, if effects are protracted and occur over a large area relative to undisturbed area, recovery through recruitment or immigration will be hampered. Furthermore, chronic resuspension of sediments may lead to shifts in species composition by favoring those species that are better suited to recover or those that can take advantage of the pulsed nutrient supply as nutrients are released from the seafloor to the euphotic zone (Churchill 1998).

#### 7.4.3.3 Changes in chemistry

Fishing gear can result in changes to the chemical makeup of both the sediments and overlying water mass through mixing of subsurface sediments and porewater. In shallow water this mixing might be insignificant in relation to that from tidal and storm surge and wave action, but in deeper, more stable, waters, this mixing can have significant effects (Rumohr 1989). In a shallow, eutrophic sound in the North Sea, fishing caused an increase in average ammonia content (although horizontal variations prevented interpretations of these increases) and a decrease in oxygen due to the mixing of reduced particles from within the sediments (Reimann and Hoffman 1991). Also in the North Sea, fishing enhances phosphate released from sediment by 70-380 tonnes per year for otter trawls and by 10,000-70,000 tones per year for beam trawlers (ICES 1992).

It is unclear how changes in chemistry might affect fish populations. During seasons when nutrients are low, the effective mixing of the sediments could cause increased phytoplankton primary production and/or eutrophication. Rijnsdorp and Van Leeuwen (1996) found increased growth (based on back calculated growth from otolith growth zones) in the smallest size classes of plaice in the North Sea correlated to eutrophication in nearshore areas and both eutrophication and increased beam trawling farther offshore. The authors hypothesized that increased nutrient release (availability) due to anthropogenic activities, including fishing, increased prey availability, and thus resulted in higher growth. Alternatively, ICES (1992) concluded that these pulses are compensated by lower fluxes after the trawl has passed, and that the releases from fishing gear that recycle existing nutrients are probably less influential than new inputs from rivers and land runoff (ICES 1992).

#### 7.4.3.4 Changes to benthic community

Benthic communities are affected by fishing gear through damage to the benthos in the path of the gear and disturbance of the seafloor to a depth of up to 12 inches. Many kinds of epibenthic animals are crushed or buried, while infauna is excavated and exposed on the seabed.

Specific impacts from fishing depend on the life history, ecology and physical characteristics of the biota present (Bergman and Van Santbrink 2000). Mobile species that exhibit high fecundities and rapid generation times will recover more quickly than non-mobile, slow-growing organisms. In Mission Bay, California, polychaetes with reduced larval phases and postlarval movements had small-scale dispersal abilities which permitted rapid recolonization of disturbed patches and resulted in maintenance of high infaunal densities (Levin 1984). Those with long-lived larvae were only available for successful recolonization if the timing of disturbance coincided with periods of peak larval abundance, however, these species were able to colonize over much larger distances. In the Wadden Sea, 60 years of observations revealed long-term changes in abundance and species composition of benthic communities as a result of continued trawling (Rinjsdorp 1988). Slow growing and reproducing epibenthic species had been replaced by fast growing species, the total number of individuals had grown, and the diversity of species of molluscs and crustaceans had decreased while that of polychaetes had increased.

The physical structure of biota also affects their ability to sustain and recover from physical impacts with fishing gear. Thin shelled bivalves and starfish show higher damage than solid-shelled bivalves in fished areas (Rumohr and Krost 1991). Animals that are able to retract below the surface of the seafloor or live below the penetration depth of the fishing gear will sustain much less damage than epibenthic organisms. Animals that are more elastic and can bend upon contact with fishing gear will suffer much less damage than those that are hard and inflexible (Eno *et al.* 2001). Kaiser *et al.* (2000a) found that chronic fishing around the Isle of Mann, UK had removed large-bodied fauna such that benthic communities are now dominated by smaller-bodied organisms that are less susceptible to physical disturbance.

Increased fishing pressure can also lead to changes in distribution of species, either through movement of animals away from or towards the fished area (Kaiser and Spencer 1993 and1996, Ramsay *et al.* 1996, Kaiser and Ramsay 1997, Ramsay *et al.* 1998, Bradshaw *et al.* 2000, Demestre *et al.* 2000). For example, Morgan *et al.* (1997) documented large scale changes in the structure of spawning cod shoals after otter trawling, and concluded that high trawling effort could lead to persistent disturbances over large distances. On the other hand, opportunistic feeders are attracted to areas disturbed by mobile fishing gear. Frid and Hall (1999) found higher prevalence of fish remains and scavengers and a lower abundance of sedentary polychaetes in stomach contents of dabs in the North Sea in areas of higher fishing effort. Kaiser and Spencer (1994) document that gurnards and whiting aggregate over beam trawl tracks and have higher numbers of prey items in their stomachs shortly after trawling. Based on these studies, researchers have speculated that mobile fishing may lead to increased populations of species that exhibit opportunistic feeding behavior. Fonds and Groenewold (2000) modeled results for the southern North Sea indicated that the annual amount of food supplied by beam trawling is approximately 7% of the food demand of common benthic predators. This level could help maintain populations but is insufficient to support further population growth (Appendix 3of Amendment 13).

### 7.4.3.5 Changes to ecosystem

The role these physical and community effects have on harvested populations is unknown in most cases. However, a growing body of empirical observations and modeling suggests that effects can be seen in population responses. For example, population models for Atlantic cod indicate that when the adult stock is at low levels (i.e., spawning and larval survivorship does not produce sufficient recruits to saturate available habitats), a reduction in habitat complexity has measurable effects on population dynamics. Off the northwest shelf of Australia, removal of epibenthic fauna by trawling resulted in a switch of dominant species from Lethrinids and Lutjanids (which are almost exclusively associated with habitats supporting large epibenthos) to Saurids and Nemipterids (which were found on open sand; Sainsbury 1998). The ICES Impact II Report edited by Lindeboom and deGroot (2001) concludes that bottom trawling affected the food web structure of the North Sea and Irish Sea, although the magnitudes and seriousness of the consequences of these effects on ecosystem properties are uncertain (Appendix 3of Amendment 13).

#### 7.4.3.6 Summary of literature reviews on gear effects

A number of authors have reviewed existing scientific literature on the effects of fishing on habitat (Kenchington 1995, Auster *et al.* 1996, Collie 1998, Jennings and Kaiser 1998, Rogers *et al.* 1998, Auster and Langton 1999, Hall 1999, Collie *et al.* 2000, Lindeboom and de Groot 2000, Barnett 2001).

Collie *et al.* (2000) analyzed 39 published studies to compile and evaluate current findings regarding fishing gear effects on habitat. Regarding the type and use of research, the authors found: (1) 89% of the studies were undertaken at depths less than 200 feet; (2) otter trawl gear is the most frequently studied; (3) most studies have been done in Northern Europe and East North America. The authors also had several conclusions pertaining to effects of fishing gear: (1) intertidal dredging and scallop dredging have the greatest initial effects on benthic biota, followed by otter trawling and then beam trawling (although beam trawling studies were conducted in dynamic sandy areas, where effects might be less apparent); (2) fauna in stable gravel, mud and biogenic habitats are more adversely affected than those in less consolidated coarse sediments; (3) recovery appears most rapid in less physically stable habitats (inhabited generally by more opportunistic species); (4) we may accurately predict recovery rates for small-bodied taxa, but communities often contain one or two long-lived, vulnerable species; (5) large-bodied organisms are more prevalent before trawling (Greenstreet and Hall 1996, Frid and Clark 1999, Veale *et al.* 2000); and (6) the mean initial response to fishing impacts is negative (55% reduction of individual taxa). Based on these findings, the authors suggest that the scientific community abandon short-term small-scale experiments and argue for support to undertake larger scale press and relaxation experiments that mirror the timing and frequency of disturbance by commercial fishing (Appendix 3 of Amendment 13).

Auster *et al.* (1996) reviewed 3 studies of mobile fishing gear in the Gulf of Maine and concluded that mobile fishing gear alters the seafloor, and reduces complexity, sedimentary structures, and emergent epifauna. Collie (1998) reviewed studies from New England and concluded that results indicate significant impacts of bottom fishing gear on benthic habitats. Auster and Langton (1999) discuss both long-term and short-term effects on structural components of habitat, community structure, and ecosystem processes, as well as the implications of these effects for management. Kenchington (1995) reviewed studies on effects of mobile gear in the North Sea, Atlantic Canada, and Scotland. While many of these reviews focus on a given gear type or a specific geographic area, most agree that fishing has at least some negative impact on the seabed and benthos. Furthermore, literature presented in these reviews suggest that chronic fishing has led to changes in community structure in many areas of the world (Dayton *et al.* 1995, Jennings and Kaiser 1998, Collie *et al.* 2000a and b).

### 7.4.4 Evaluation of impacts on habitat

#### 7.4.4.1 Fishing gears used in the Northeast

The NMFS (USDC 2001) report entitled *The Effects of Fishing on Marine Habitats of the Northeastern United States* (Appendix 3 of Amendment 13) addresses the various fishing gear that are in use in the Northeast and provides an evaluation of the impacts of the various gear to different habitats. The Council concurs with those sections identified by NMFS in the report.

The Northeast Region falls within the jurisdiction of the New England and Mid Atlantic Fishery Management Councils as well as the individual States from Maine through North Carolina which are represented by the Atlantic States Marine Fisheries Commission (ASMFC). These jurisdictions are responsible for the management of many different fisheries extending from the upper reaches of the estuaries out to 200 miles offshore at the EEZ.

The EFH regulations promulgated pursuant to the Magnuson-Stevens Fishery Conservation and Management Act require that Fishery Management Plans contain an assessment of all potential adverse effects of all fishing equipment types used in EFH. This review includes gear managed by the Councils as well as those gear used exclusively in state waters. Fifty-nine categories of fishing gear were identified as having been associated with landings of Federal or state managed species based on a review of the National Marine Fisheries Service commercial fisheries landings data for 1999 and an ASMFC report on gear impacts to submerged aquatic vegetation (Stephan *et al.* 2000).

For this review of the impacts of fishing activities on EFH, gears of concern are those that have been identified as having landed any amount of species managed by either the NEFMC or MAFMC (Table 13 of Amendment 13) as well as gears that contributed 1% or more of any states total landings for all species (Table 14 of Amendment 13). Although certain gear types are not managed under the auspices of the MSA, this methodology recognizes that certain gear utilized in state waters may have adverse impacts to EFH that is designated in nearshore or estuarine areas. Table 15 of Amendment 13 provides the list of all 59 gears considered for this review and indicates whether the gear is utilized in estuaries, coastal waters (0-3 miles), or offshore waters (3-200 miles). Since the seabed is the location of the habitat types most susceptible to gear disturbances, Table 15 of Amendment 13 also indicates whether the gear contacts the bottom.

Figure 34 of Amendment 13 provides a general indication of the areas that are being fished based upon landings, in the New England States compared to the Mid-Atlantic States based on landings for 1999. On a relative scale, using landings as a very rough proxy for fishing effort, most of the fishing effort in New England is in the offshore waters (> 3 miles) compared to inshore waters (< 3 miles) for Mid-Atlantic States. Figure 35 of Amendment 13 shows how this compares for each State from Maine through North Carolina based on landings for 1999.

For the purposes of this review, the various gear types have been placed into 3 categories: 1) bottom-tending mobile gear; 2) bottom-tending static gear, and; 3) mobile and static pelagic gear. The gear types were also placed into functional categories to allow for a more generalized discussion of potential impacts due to a lack of specific information for all gear types.

Gear descriptions included in the report (Appendix 3 of Amendment 13) were originally prepared for the New England Fishery Management Council Essential Fish Habitat amendment in 1998. Primary sources for these descriptions were Sainsbury (1996), Carr and Milliken (1998), and DeAlteris (1998).

#### 7.4.4.2 Distribution of fishing trips by gear type

Numbers of fishing trips made by Federal vessel permit holders in the northeast United States (North Carolina - Maine) during the period 1995 - 2000 were aggregated for 18 individual gear types and 3 major gear categories (Table 16 of Amendment 13), assigned to 10 minute "squares" of latitude and longitude, and plotted to show spatial distribution patterns. Logbook data included in the analysis are currently provided by vessels operating in Federal waters and participating in the following fisheries: northeast multispecies; sea scallops; surfclams and ocean quahogs; monkfish; summer flounder, scup, and black sea bass; squid, mackerel, and butterfish; spiny dogfish; bluefish; Atlantic herring; and tilefish. Logbook data provided by ocean quahog and surfclam dredge vessels are archived in a separate database and were analyzed separately. Data for lobster pots were provided by vessels with multispecies permits. Vessels that operate strictly within state waters (0-3 miles from shore) are not required to have a Federal permit and therefore do not submit logbooks. For this reason, fishing trips in nearshore 10 minute squares that include a significant proportion of state water were under-represented.

Permit holders are required to submit a vessel trip report each time they make a fishing trip. A trip is defined as a single departure and return to port. Actual fishing time could not be computed because the only temporal datum that was common to all gear types was total trip duration. Although some additional information is available (the number of hauls and average duration of each haul) which could possibly be used to obtain more precise estimates of fishing time for mobile gear types such as bottom trawls and dredges, it is not reported for all trips and is meaningless when applied to stationary gear types such as pots and gill nets. No attempt was made to estimate fishing time for this analysis. Therefore, the results presented here are not intended to represent the spatial distribution of fishing effort.

Permit holders are given the option of reporting the location of a trip as a point (latitude and longitude or Loran bearings) or inside a statistical area. Only trips which were reported as a point location and therefore could be assigned to a 10 minute square were included in this analysis. Trips made south of 35º N latitude (Cape Hatteras) or north of 45º N latitude (U.S.-Canada border in the Bay of Fundy) were excluded from this analysis. Each ten minute square covers an area of 100 square miles or 259 square kilometers (Appendix 3 of Amendment 13).

Plots of the cumulative number of fishing trips by ten minute square were made for each gear type using ArcView. Data were classified using a statistical formula (Jenk's optimization) that identifies natural breakpoints between classes. This is the default classification method used in ArcView. It provided more demonstrable groupings of the data than the other classification methods that were available. For gear types or groups with >150,000 trips, all 10 minute squares with <10 trips were eliminated in order to "clean up" the distribution plots. For gear types with 20,000-70,000 trips, all 10 minute squares with <5 trips were eliminated from the plots; for gears with 4,000-15,000 trips, squares with only a single trip were eliminated; and for gears with <4,000 trips, all trips were used. The number of trips noted at the top of each plot (N) is the number of trips represented in the plot, not (in most cases) the total number of trips (Appendix 3 of Amendment 13).

Overall, 752,681 trips were included in the analysis, representing 79.5% of all trip reports submitted during the six-year period for these 18 gear types (Table 16 of Amendment 13). Most (98.4%) of these trip reports were included in the GIS plots. For individual gears, the "coverage" varied from 30.8 to 100%, with Danish seines ranking the lowest and hydraulic and non-hydraulic clam dredges ranking the highest. For the major gear types (gears with >4,000 analyzed trips), the percentages of reported trips that were analyzed ranged from 72.8 to 100%.

### 7.4.4.3 Hydraulic clam dredges

### 7.4.4.3.1 Hydraulic clam dredges – description

Hydraulic dredges are used to extract clams from the sediment. In hydraulic dredging, high pressure water jets ahead of the rake teeth or blade are used to scour out the shells which are then dug up by the blades and passed back into the bag. High pressure water is supplied to the jets through a hose from the operating vessel by a diesel pump and the bag is generally carried on a heavy sled. This gear is generally fished in relatively shallow inshore and estuarine areas (Sainsbury 1996).

In the Atlantic surfclam (*Spisula solidissima*) fishery, large vessels (>95 feet), tow dredges up to 15 feet in width slowly across the seabed. The vessels are equipped with large pumps, connected to the dredges via flexible hoses, that use water and inject it into the sediment through a manifold with multiple nozzles, ahead of the blade of the dredge. The dredge must be towed slowly so as to not exceed the liquefaction rate. These dredges, operated correctly, are highly efficient, taking as much as 90% of clams in their path. A secondary species that is also harvested in this fishery is the ocean quahog, *Arctica islandica*.

A fishing gear impacts workshop was held in Boston in October 2001 that reviewed and discussed exactly how the hydraulic and nonhydraulic (Maine ocean quahog fishery) clam dredges operate and what their potential impacts could be. The panelists heard presentations and had discussions on: 1) the actual fishery descriptions, 2) the effects of the fishery on the environment, 3) the strength of the evidence of those effects, and 4) what potential management implications were possible. The full discussion of the clam dredge analyses from the workshop is presented here and the full workshop report evaluating all gear is included in Amendment 13 as Appendix 4.

Mr. Dave Wallace (Wallace and Associates) presented a thorough description of the evolution and current use of the hydraulic clam dredge for the surfclam and ocean quahog fisheries. A brief discussion of “dry dredges” used in the Maine “mahogany” ocean quahog fishery was led by Wallace with contributions from the workshop panelists. Subsequent to the workshop, Wallace (pers. comm.) has additionally estimated that the average hydraulic clam dredge takes about 600 man-hours to build and constitutes an investment of almost $30,000 (without hoses and pumps). Thus, industry is quite leery of hanging the dredge up and potentially losing it. This section of the report summarizes his presentation and the panel discussion.

Hydraulic clam dredges have been used in the surfclam fishery for over five decades and in the ocean quahog fishery since its inception in the early 1970s. These dredges are highly sophisticated and are designed to: 1) be extremely efficient (80 to 95% capture rate); 2) produce a very low bycatch of other species; and 3) retain very few undersized clams.

The typical dredge is 12 feet wide and about 22 feet long and uses pressurized water jets to wash clams out of the seafloor. Towing speed at the start of the tow is 2.5 knots and declines as the dredge accumulates clams. The dredge is retrieved once the vessel speed drops below 1.5 knots, which can be only a few minutes in very dense beds. However, a typical tow lasts about 15 minutes. The water jets penetrate the sediment in front of the dredge to a depth of about 8 - 10 inches, depending on the type of sediment and the water pressure. The water pressure that is required to fluidize the sediment varies from 50 pounds per square inch (psi) in coarse sand to

110 psi in finer sediments. The objective is to use as little water as possible since too much pressure will blow sediment into the clams and reduce product quality. The "knife" (or "cutting bar") on the leading bottom edge of the dredge opening is 5.5 inches deep for surfclams and 3.5 inches for ocean quahogs. The knife "picks up" clams that have been separated from the sediment and guides them into the body of the dredge ("the cage"). If the knife size is not appropriate, clams can be cut and broken, resulting in significant mortality of clams left on the bottom. The downward pressure created by the runners on the dredge is about 1 psi.

It was pointed out by a panel member that the high water pressure associated with the hydraulic dredge can cause damage to the flora and fauna associated with bottom habitats. However, water pressure greater than that required for harvesting will reduce the quality of the clams by loading them with sand and increase the rate of clam breakage. Therefore, water pressure is usually self regulated.

There are currently two types of hydraulic dredges used in the fishery, stern rig dredges and side rig dredges. The chain bag on a side rig dredge drags behind the dredge and helps smooth out the trench created by the dredge. The chain bag results in significantly more damage to small clams and other bycatch than occurs with the stern rig dredge. With the stern rig dredge, which is basically a giant sieve, small clams and bycatch fall through the bottom of the cage into the trench and damage or injury is minimal. Improvements in gear efficiency have reduced bottom time and helped to limit the harvest of surfclams to a relatively small area in the mid-Atlantic Bight.

Prior to 1990, the resource was managed by controlling the number of hours a vessel could fish. Consequently, towing speeds were maximized to catch as many clams as possible regardless of the damage done to the clams or the habitat. Cutting and breakage of discarded clams were estimated to be as high as 90% in some locations and under some conditions decomposition of dead clams caused reduced oxygen concentrations in sediments to the point that clams were killed. Incidental mortality is currently estimated to be well under 10% because quota management has removed the need for vessels to catch as many clams as possible as quickly as possible.

Concurrent with the change in harvesting practices that occurred after 1990, there has also been a significant reduction in fishing effort and a shift to stern rig dredges. About 60 side-rig vessels pulling 80 dredges were taken out of the fishery after 1990. The number of surfclam vessels decreased from 128 in 1990 to 35 in 2001, while the number of vessels that landed ocean quahogs (excluding the Maine fishery) dropped from 56 in 1990 to 30 in 2001. Currently there are only 4 side rig vessels pulling five dredges left in the fleet.

Surfclams live mostly in sand which is disturbed and re-suspended by storms and, in some locations, by strong bottom currents. Ocean quahogs live at greater depths, mostly in finer sand and silt/clay substrates which are less affected by natural physical disturbances. Surfclams and ocean quahogs are not found in commercial quantities in gravel or mud habitats or in depths greater than about 250 feet.

Hydraulic clam dredges can be operated in areas of large grain sand, fine sand, sand and small grain gravel, sand and small amounts of mud, and sand and very small amounts of clay. Most tows are made in large grain sand. Dredges are not fished in clay, mud, pebbles, rocks, coral, large gravel greater than one half inch, or seagrass beds. Boat captains will not dredge in areas with very soft or hard substrate where they run the risk of losing or damaging the gear. The fishery is also limited to sandy sediment because the processors do not want mud blown into the clam bodies by the dredge.

The spatial scale of fishing effort varies depending on which species is the target: surfclams are harvested primarily in a small area off the New Jersey coast whereas ocean quahogs are harvested over a larger area that includes offshore waters. Areas with denser concentrations of clams would presumably be dredged more intensively, i.e., a higher percentage of the bottom would be affected. Because surfclams are concentrated in a very defined area off the New Jersey coast where the bottom is so homogeneous, a high proportion of the bottom over this large contiguous area is affected by dredging. Surfclams grow much more rapidly than ocean quahogs and surfclam beds are dredged every few years. Areas dredged for ocean quahogs are left untouched for many years. Ocean quahogs are much more likely to be dredged from a number of more or less discrete patches that are surrounded by undisturbed areas. It was noted, as a general rule, that once 50% of the harvestable clams are removed from an area, the catch rates drop to a point where it is no longer economically feasible for fishing to continue there.

In Federal waters, the amount of bottom area directly impacted by the hydraulic clam dredge fleet in 2000 was about 110 square nautical miles (Table 2 of Amendment 13). An additional 15 square nautical miles were dredged in State waters of New Jersey, New York, and Massachusetts. The predominant substrate on the southern New England/Mid-Atlantic Bight shelf is sand. Thus, during any given year, this fishery is conducted in a very small proportion of a habitat type that characterizes most of the 40,000 square nautical miles of continental shelf between the Virginia/North Carolina border and Nantucket Island (69/ W longitude). The Georges Bank region has been closed to clam harvesting since 1990 because of the potential of paralytic shellfish poisoning.

The dry dredge used in the Maine fishery is a cage with wide skis and a series of teeth about 6 inches long in the front. These dredges are used on smaller boats (about 30 to 40 feet long) and are pulled through the seabed using the boat's engine. The cutter bar is limited to a width of 36 inches by State law. This fishery takes place in small areas of sand and sandy mud found among bedrock outcroppings in depths of 30 to > 250 ft in state and Federal coastal waters north of 43 degrees 20 minutes N latitude. The dredges scoop up clams and sediment, and the vessel's propeller wash is used to clean out the sand and mud.

Trips reported by vessels using hydraulic clam dredges during 1991-2000 were made over a broad area of the continental shelf from Cape Cod to the Delmarva peninsula (Figures 37 and 38 of Amendment 13). Areas where fishing with this gear type was concentrated (235 trips per 100 square nautical miles) were located off the New Jersey coast and south of Long Island. Dredging in southern New England was less intense. The concentration of the "dry" dredge in the Maine ocean quahog fishery is depicted in Figure 39 of Amendment 13.

#### 7.4.4.3.2 Hydraulic clam dredges - impacts and recovery

The following information is from a draft report by Stevenson *et al.* entitled *"The Effects of Fishing on Marine Habitats of the Northeastern United States"* that is to be finalized in the late summer of 2003. This report is an updated/expanded version of the report in Appendix 3of Amendment 13.

**Hydraulic Clam Dredges – Mud**

Hall and Harding (1997) evaluated the effects of suction dredging on intertidal infaunal communities in Auchencairn Bay, on the north side of the Solway Firth, on the west coast of Scotland. Sediments were 60-90% silt/clay in the interior of the bay and 25-60% silt/clay in the center and outer parts of the bay. Commercial dredging for cockles (*Cerastoderma edule*) in the bay was prohibited four and a half months before experimental dredging began. Core samples were collected in control plots prior to dredging, and in experimental plots immediately after, and one, four, and eight weeks after dredging. Dredge tracks could not be seen after the first day. The total number of infaunal individuals and species increased in both plots over time, but were significantly lower in the experimental plots than in the control plots immediately after dredging and after four weeks. Species diversity also increased significantly over time, but was not significantly different in the two plots at any point during the experiment. Three of the five dominant species were significantly reduced by dredging over the course of the study. By the end of the study (eight weeks), much of the difference between dredged and control sites had been lost, but the disturbed plots still had a higher partial-dominance index.

**Summary**

Results of a single experimental study are summarized here. It examined the physical and biological effects of individual suction dredge passes in an intertidal mud habitat and monitored recovery for eight weeks. Dredging produced dredge tracks that disappeared after one day. There were significant reductions in the total number of infaunal individuals and species that lasted four weeks, and three out of five dominant species were reduced in abundance during the entire eight-week duration of the experiment. However, infaunal community structure recovered nearly completely by the end of the experiment.

**Hydraulic Clam Dredges – Sand**

(1). Hall *et al.* (1990) studied the physical and biological effects of a commercial escalator dredge used to harvest razor clams (*Ensis* spp.) in a shallow sea loch (Loch Gairloch) on the west coast of Scotland in November 1989. The depth at the study site was 22 feet and the sediment was fine sand. It was located near a recently-dredged area, but was not exploited itself. Experimental and control plots were visually inspected and sampled by divers immediately after dredging and 40 days later. Each experimental plot was dredged intensively for approximately five hours in order to simulate commercial fishing activity. After dredging, the experimental plots were crisscrossed by shallow trenches (0.5 m wide and 10 inches deep) interspersed with larger holes (up to 10 feet wide and 2 feet deep) that were presumably produced when the dredge remained stationary for a brief period. Sediment in the holes and trenches was "almost fluidized" and sand in the bottom of the trenches had a significantly higher median particle size. After 40 days, however, none of these features remained.

The number of infaunal species and individuals were reduced in the experimental plots immediately after dredging (significantly, for individuals), but there were no detectable differences between experimental and control plots 40 days later. There were no significant differences in the abundance of individual species in the control and experimental plots on either sampling occasion. The authors concluded that dredging caused a short-term, non-selective reduction in the numbers of all infaunal species and that recovery from physical effects was accelerated by a series of winter storms and considerable sediment disturbance in the study area.

No attempt was made to assess the mortality of large polychaetes and crustacea that were observed to be retained on the wire mesh conveyor belt or fell off the end of the belt, or ocean quahogs (*Arctica islandica*) that were often cracked by the dredge.

(2). Kaiser *et al.* (1996b) investigated the effects of suction dredging for cultivated manila clams (*Tapes philippinarum*) on a muddy sand intertidal flat in southeast England in December 1994. Samples of benthic infauna and sediment were collected prior to, three hours after, and seven months after harvest in one cultivated plot and in nearby control locations. There were significantly higher densities of infaunal organisms in the cultivated plot prior to dredging, but no differences in the number of species or in four indices of taxonomic diversity. Large amounts of fine sand were re-suspended by the dredge, exposing the underlying clay. There were also significant reductions in the mean numbers of infaunal species and individuals in the dredged plot immediately after harvest, to values that were statistically the same as in the control locations. Crustaceans and bivalve mollusks were particularly affected. Seven months later there were no significant differences between the benthic community in the harvested plot and in the control locations and the proportion of fine sand in the harvested plot had increased significantly, indicating that recovery from the effects of clam cultivation and harvesting was complete.

(3). MacKenzie (1982) sampled benthic invertebrate assemblages in three ocean quahog beds with contrasting fishing histories located about 40 miles east of Cape May, New Jersey (USA), in the mid-Atlantic Bight, in October 1978. One bed had never been fished, one had been actively fished for two years, and one had been fished for about a year but then abandoned 4-5 months prior to this study. All three beds were in very fine to medium sand sediments in 110 feet of water. Commercial dredging was conducted with cage dredges in this area. Sampling was limited to a total of 30 grab samples from all three sites. No significant differences were found in numbers of invertebrate individuals or species, or in species composition, between previously dredged and un-dredged areas or between dredged and un-dredged sample locations at the two fished sites. Hydraulic dredging thus did not appear to have any lasting effect on the invertebrate populations in these beds. Comparison of samples from dredged and un-dredged sample locations also indicated that hydraulic jetting of the bottom re-sorts bottom sediments, leaving shell fragments on the surface and coarser sediments at the bottom of dredge tracks.

(4). Maier *et al.* (1995) assessed the effects of escalator dredges in four muddy sand tidal creeks in South Carolina (USA) by comparing pre- and post-dredging turbidity levels and benthic infaunal assemblages. Turbidity was monitored two weeks before, during, and two weeks after dredging at one location and during and immediately after dredging at another. Infaunal samples were collected three weeks before and two weeks after dredging in a creek that had been commercially dredged five years prior to the study and in a creek that had never been dredged before. Turbidity was elevated in the vicinity of the dredge and immediately downstream while it was operating, but the sediment plumes only persisted for a few hours. Sampling failed to detect any significant changes in the abundance of dominant infaunal taxa, or in the total numbers of individuals, after dredging.

(5). Medcof and Caddy (1971) utilized divers and a submersible to compare the physical effects of a hydraulic clam dredge and a non-hydraulic toothed scallop dredge in shallow water (20 to 35 feet) sand inlets in Nova Scotia (Canada). On sand and sand-mud habitats, hydraulic dredges left smooth tracks with steeply cut walls that averaged 8 inches deep and slowly filled in by slumping. The hydraulic dredge raised a sediment cloud which seldom exceeded 2 feet in height and usually settled within 1 minute. Dredge tracks were still easily recognizable after 2-3 days.

(6). Meyer *et al.* (1981) observed the effects of a small (4 feet wide) hydraulic clam cage dredge in an un-harvested surfclam bed located near Rockaway Beach on the south shore of Long Island, New York (USA). The study was conducted in 1977, three years after the area was closed to commercial clamming. The sediment in the study area was fine to medium sand covered with a 3 inch-thick layer of silt and the maximum depth was 100 feet. The study area was exposed to strong bottom currents that caused considerable movement of sand. As part of a larger study to evaluate gear performance, the effects of dredging on bottom substrate and fauna were assessed by divers during a single 2-minute tow immediately after and 2 and 24 hrs after dredging. The dredge formed trenches which were initially rectangular, as wide as the dredge, and over 8 inches deep. Mounds of sand 6 to 15 inches wide and 2 to 6 inches high were formed on either side of the trench. The dredge raised a cloud of silt 1 to 5 feet in height, which settled within four minutes. Slumping of the trench walls began immediately after the tow and became more apparent with time. Two hours after dredging, slumping of the trench walls had rounded the depression. After 24 hours the dredge track was less distinct, appearing as a series of shallow depressions, and was difficult to recognize. The dredging attracted predators, with lady and rock crab preying on damaged clams, and starfish, horseshoe crabs and moon snails attacking exposed but undamaged clams. By 24 hours after dredging, the abundance of predators appeared to have returned to normal, and the most obvious evidence of dredging was whole and broken clam shells without meat.

(7). Pranovi and Giovanardi (1994) studied the effects of an 8 foot wide hydraulic cage dredge in 5 to 7 foot depths in the Venice Lagoon (Italy, Adriatic Sea). Divers collected samples of sediment and benthic organisms from experimentally-dredged and control areas at two sites inside and outside a commercial fishing ground immediately after experimental dredging and every three weeks for two months. A single tow with a commercial dredge was made at each site. The dredge created 3 to 4 inch-deep furrows, one of which was clearly visible two months later. In this study, sediment grain size was not significantly affected by dredging, although portions of the fishing grounds which had been predominantly silt and clay 15 years earlier had a considerably higher sand content at the time of the study. Hydraulic dredging in this area often cracks the shells of bivalves. Within the fishing grounds, total numbers and biomass of benthic infauna and epifauna were significantly reduced in the experimental plot immediately following dredging. Densities, especially of small species and epibenthic species, recovered two months later, but biomass did not. Inside the fishing ground, there were also fewer species in the dredged area than in the control area immediately after, and three and six weeks after, dredging, but no differences two months afterwards. Outside the fishing ground, immediately after passage of the dredge, there were no significant faunal differences between dredged and undredged areas.

(8). Tuck *et al.* (2000) examined the effects of hydraulic dredging on the seabed and benthic community in a shallow (6 to 15 feet), sandy site in the Outer Hebrides (Sound of Ronay), on the west coast of Scotland in March 1998 that was closed to commercial dredging. Sediments in the study area consisted of moderately well-sorted medium or fine sand and tidal currents reached speeds as high as three knots. Divers collected core samples and made observations and video recordings, before, during, and after dredging inside and outside six dredge tracks and returned to re-examine the site 5 days and 11 weeks after dredging. The dredge was a commercial dredge used to harvest razor clams that employs a hollow blade that protrudes 1 foot into the sediment with holes that direct pressurized water forward into the sediment.

Immediately after dredging the track had distinct vertical walls and a depth similar to the dredge blade. However, once the dredge was hauled, the side walls collapsed and the tracks had a flat-bottomed "V" shape. The sediment within the base of the tracks was fluidized to a depth of approximately 1 foot and within both side walls to approximately 6 inches. The tracks were still clearly visible after five days, but less pronounced, and the depth of fluidized sediment remained the same. After 11 weeks the tracks were no longer visible, but 8 inches of sand was still fluidized. Immediately after fishing, there was significantly less silt in the sediments inside the tracks than outside, but there was no difference after five days. Numerically, the infauna at the study site was dominated by polychaetes. There was a significant decrease in the proportion of polychaetes, and an increase in amphipods, in the dredge tracks within five days of dredging, but not after 11 weeks. Bivalves were not affected by dredging. Within a day of dredging the total number of species and individuals was significantly lower in the dredge tracks, but there was no difference after five days. Dredging had an immediate effect on the abundance of a number of individual species, but no effects were detected 11 weeks after dredging. Owing to the strong currents, there was a very sparse epifauna in the area: the only observed effect of dredging was the attraction of crabs into the area to scavenge on material disturbed by the dredge.

**Summary**

Results of eight hydraulic dredge studies in sandy substrates are summarized in this report. Five of them examined the effects of "cage" dredges of the type used in the Northeast region of the U.S. (3, 5-8) and three examined the effects of escalator and suction dredges. Three of them were published prior to 1990, and five since then. Four were performed in North America, one in the Adriatic Sea and three in the United Kingdom. One study was conducted on the U.S. continental shelf at a depth of 110 feet, five in shallower, nearshore waters (5 to 40 feet), and two in intertidal environments. Three studies were observational in nature and five were controlled experiments. Three studies compared effects in commercially-dredged and un-dredged areas and four were conducted in previously un-dredged areas. Six studies examined the effects of individual dredge passes, one evaluated the effects of repeated passes in the same area during a short period of time, and one compared infaunal communities in an actively dredged, a recently dredged, and an un-dredged location. Seven studies examined physical and biological effects and one was limited to physical effects. All of the biological studies examined effects to infauna. Recovery was evaluated in four cases for periods ranging from 40 days to seven months.

**Physical effects**

Hydraulic clam dredges created steep-sided trenches 3 to 12 inches deep that started deteriorating immediately after they were formed (1, 5-8). Trenches in a shallow, inshore location with strong bottom currents filled in within 24 hours (6). Trenches in a shallow, protected, coastal lagoon were still visible two months after they were formed (7). Hydraulic dredges also fluidized sediments in the bottom and sides of trenches (1, 8), created mounds of sediment along the edges of the trench (6), re-suspended and dispersed fine sediment (2, 4-6), and caused a re-sorting of sediments that settled back into trenches (3). In one study (8), sediment in the bottom of trenches was initially fluidized to a depth of 12 inches and in the sides of the trench to 6 inches. After 11 weeks, sand in the bottom of the trench was still fluidized to a depth of 8 inches. Silt clouds only last for a few minutes or hours (4-6). Complete recovery of seafloor topography, sediment grain size, and sediment water content was noted after 40 days in a shallow, sandy environment that was exposed to winter storms (1).

**Biological effects**

Some of the larger infaunal organisms (*e.g.*, polychaetes, crustaceans) retained on the wire mesh of the conveyor belt used in an escalator dredge, or that drop off the end of the belt, presumably die (1). Benthic organisms that are dislodged from the sediment, or damaged by the dredge, temporarily provided food for foraging fish and invertebrates (1, 6). Predator densities returned to normal within 24 hours in one study (6). Hydraulic dredging caused an immediate and significant reduction in the total number of infaunal organisms in three separate studies (1, 2, 8) (but not in another (4)) and in the number of macrofaunal organisms in a fourth study (7). There were also significant reductions in the number of infaunal species in two cases (2, 8) and in the number of macrofaunal species and biomass in a third case (7). In one study, polychaetes were most affected (7). Two studies failed to detect any reduction in the abundance of individual taxa (1, 4). Evidence from the study conducted off the New Jersey coast indicated that the number of infaunal organisms and species, and species composition, were the same in actively dredged and un-dredged locations (3).

Recovery times for infaunal communities were estimated in four studies. Three of these studies (1,7, 8) were conducted in very shallow (5 to 22 feet) water and one (2) in an intertidal environment. Total infaunal abundance and species diversity had fully recovered only five days after dredging in one location where tidal currents reach maximum speeds of three knots (8). Some species had recovered after 11 weeks. Total abundance recovered 40 days after dredging in another location exposed to winter storms, when the site was re-visited for the first time (1). Total infaunal abundance (but not biomass) recovered within two months at a protected, commercially-exploited site (7), where recovery was monitored at three-week intervals for two months, but not at a nearby unexploited site. Full recovery at the intertidal site was noted seven months after it was suction dredged when it was re-visited for the first time (2). Actual recovery times at this site and at one of the exposed sub-tidal sites (1) may have been much quicker than seven months and 40 days.

**Hydraulic Clam Dredges - Mixed Substrates**

Murawski and Serchuk (1989) used manned submersibles to observe effects of hydraulic dredging on sand, mud, and gravel bottom habitats in a number of offshore locations in the mid-Atlantic Bight (U.S. Atlantic coast) between Delaware Bay and Long Island (water depths not reported). They reported that hydraulic cage dredges penetrate deeper into the sediments and, on a per-tow basis, result in greater short-term disruption of the benthic community and underlying sediments than do scallop dredges (no data were provided). In coarse gravel, the sides of hydraulic dredge trenches soon collapsed, leaving little evidence of dredge passage. There was also a transient increase in bottom water turbidity. In finer-grained, hard-packed sediments, tracks persisted for several days after dredging. Non-harvested benthic organisms (*e.g.*, sand dollars, crustaceans, polychaetes) were substantially disrupted by the dredge. Sand dollar assemblages appeared to recover quickly, but short-term reductions in infaunal biomass were considered likely. Numerous predatory fish (*e.g.*, red hake, spotted hake, and skates) and invertebrates (rock crabs and starfish) were observed in and near dredge tracks consuming broken quahogs. Densities of crabs and starfish were estimated to be 2.5 times higher in dredge tracks than in nearby undredged areas within one hour of experimental tows and >10 higher 8 hrs after dredging. Presumably, benthic infauna “tilled up” by the dredge were also being consumed, since not all predators observed foraging in the dredge paths were eating damaged shellfish.

**Summary**

An *in situ* evaluation of hydraulic dredge effects in sand, mud, and coarse gravel in the mid-Atlantic Bight indicated that trenches fill in quickly, within several days in fine sediment and more rapidly than that in coarse gravel. Dredging dislodged benthic organisms from the sediment, attracting predators.

**Hydraulic Dredges - Biogenic Substrate**

(1). Godcharles (1971) evaluated the physical effects of escalator dredging in seagrass (*Thallasia testudineum* and *Syringodinium filiforme*) beds, *Caulerpa* algae beds, and bare sand bottoms (depth not given) in Tampa Bay, Florida (USA) in 1968. Dredging was conducted with a commercial dredge at six sites. Water jets penetrated sediments to a maximum depth of 20 inches and left trenches that varied from 6 to 18 inches deep. Trenches were deeper in shallow areas where propellor wash scoured loose sediments from trenches and prevented redeposition of suspended sediments. The proportion of fine sediment in some trenches decreased immediately after passage of the dredge. Virtually all attached vegetation in the path of the dredge was uprooted, leaving open bottom areas. Trenches in grass beds remained visible longest (up to 86 days) while those in sandy areas filled in immediately. Most fluidized sediments hardened within a month, but some spots were still soft 500 days after dredging. Differences in silt/clay content between tracks and undisturbed areas became negligible after a year, but seagrasses had still not re-colonized disturbed areas.

(2). Orth *et al.* (1998) assessed damage to submerged aquatic vegetation (SAV) caused by escalator dredges in Chincoteague Bay, Virginia (USA) during 1996, 1997, and 1998. They reported a large number of circular "scars" in the vegetation, with 70-100% seagrass cover outside the scarred areas and an abrupt reduction to 15% or less at the scar edge. The percent cover of seagrass was low across the scar until a second abrupt increase in cover occurred at the center where seagrass had not been disturbed. There were no measurable differences in percent cover estimates in the scarred portions of areas that were dredged during the three years of observation, indicating that re-vegetation was proceeding very slowly. There were two factors that they believed were delaying re-vegetation: an increase in depth of 4 to 8 inches in the dredge tracks and large holes inside the un-vegetated portions of the scars made by organisms such as foraging cownose rays. The authors concluded that even the most lightly impacted areas would require a minimum of five years to fully recover.

**Summary**

Two studies were performed in the southeast U.S. in shallow, sub-tidal, vegetated habitats. One of them was a controlled experiment that compared the effects of escalator dredges in vegetated (seagrass and algae) and un-vegetated areas and the other evaluated damage to seagrass beds caused by commercial escalator dredging. In the experimental study (1), water jets penetrated sand substrate to a maximum depth of 18 inches, created trenches up to 12 inches deep, up-rooted vegetation, and increased the silt/clay content of sediments in dredge tracks. Recovery times were extremely variable. In some cases, trenches were visible for only a day and in other cases for three months. In most cases, sediments hardened within a month, but in some tracks sediments were still fluidized 500 days after dredging. After a year sediment composition in dredge tracks had returned to normal, but seagrass had not re-colonized disturbed areas. There were no signs of recovery of seagrass in commercially-dredged areas three years after dredging.

#### 7.4.4.4 Scallop dredges

Scallop dredges are discussed in detail in the NMFS report (USDC 2001). The panel determined that the effects of scallop dredging were of greatest concern in the following three habitat types: high and low energy sand and high energy gravel. Surfclams and ocean quahogs are found in sandy sediment. Low energy sand habitat occurs in deeper water where the bottom is unaffected by tidal currents and where the only natural disturbance is caused by occasional storm currents. In high energy sand habitat, effects on biological structure were considered to be low, since organisms in this environment would be adapted to a high degree of natural disturbance. It is unlikely that either surfclams or ocean quahogs would be significant since the gear rides on the surface and the surfclams and ocean quahogs are buried in the sediment.

#### 7.4.4.5 Otter trawls

Otter trawls are discussed in detail in the NMFS report (USDC 2001) that is appended (Appendix 3of Amendment 13). The panel concluded that the greatest impacts from otter trawls occur in low and high energy gravel habitats and in hard clay outcroppings. Both surfclams and ocean quahogs occur almost exclusively in sandy habitat.

#### 7.4.4.6 Other gears

Gear other than hydraulic clam dredges, scallop dredges and otter trawls are discussed in some detail in the NMFS report (USDC 2001) that is Appendix 3. The panel concluded that the degree of impact caused by pots and traps to biological and physical structure and to benthic prey in mud, sand and gravel habitats was low. The panel concluded that sink gill nets and longlines cause some low degree impacts in mud, sand, and gravel habitats. Finally, the panel concluded that no management measures were necessary for beam trawls or pelagic gear because there were no impacts at this time.

### 7.4.5 Council determination of fishing impacts to surfclam and ocean quahog EFH

#### 7.4.5.1 All fishing gear 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 (1999). The gears expected to have the most adverse impact are hydraulic clam dredges and the scallop dredges (MAFMC 1999). EFH for surfclams and ocean quahogs is defined in section 2.2.3 and can be seen in Figures 30 and 31 for surfclams and 32 and 33 for ocean quahogs.

Section 2.2.5.4.3.2 of Amendment 13 discusses the impacts and recovery from hydraulic clam dredges. The Council considered the numerous studies identified above and the fact that the surfclam and ocean quahog fisheries are ITQ fisheries. As ITQ fisheries 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 2001 the number was 35. For ocean quahogs the number of vessels were: 59 in 1979, 69 in 1989 and 30 in 2001. 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.

Dr. James Weinberg (Northeast Fisheries Science Center - NEFSC) led the discussion at the fishing gear impacts workshop (Appendix 4of Amendment 13) of the direct physical and biological effects of hydraulic clam dredging, and Dr. Roger Mann (Virginia Institute of Marine Science - VIMS) led the discussion on the available evidence. Most of the evidence for dredging impacts that was considered by the panel was from the Northeast U.S., but there are studies from other areas that show the same effects. It was noted that early studies done in the Northeast region were conducted during development of the fishery, when clam dredging was more damaging to the habitat than it is now.

According to these studies, the direct physical effects of hydraulic clam dredging are basically two-fold. First, a trench about 8 inches deep is left behind the dredge and windrows of sediment and organisms are formed on either side of the trench. The second direct physical effect is the resuspension of sediment. If a dredge goes through silt or loose sediment, it produces a sediment cloud. In the panel's judgement, fine sediment may take as long as 24 hours to resettle and would end up outside the trench, while heavier particles would settle much more rapidly, primarily back into the trench. The evidence for physical effects (trench, windrows, and sediment re-suspension) is strong because these effects are so obvious.

Physical impacts to bottom habitat last longer (months) in low energy environments than in high energy environments (hours). In sand, the sides of the trench start to erode as soon as it is cut; this happens more rapidly when bottom currents are strong. The rate at which it fills in depends on the grain size of the sediment, water depth, and the strength and frequency of storms and bottom currents. It was noted that there are permanent, longshelf, sand ridges with low elevation off the New Jersey coast, but there is no evidence to indicate that clam dredges remove them, even though they may be towed through them.

The direct biological effects of hydraulic dredges vary, depending on whether organisms are hard-bodied like clams or soft-bodied like amphipods or polychaetes. What happens when a clam dredge goes through an area is not fully known and more study is needed. It was noted that structure-forming epifauna such as anemones and sponges would clearly be removed. Emergent epifauna growing on shell beds in the mid-Atlantic Bight is known to provide cover for juvenile fish species like black sea bass. Removal of these organisms, or their burial by re-suspended sediments, could therefore cause the loss of habitat for some species of juvenile fish.

It is not clear what happens to soft-bodied organisms that are moved by the dredge or pass through the trench and are deposited back on the seafloor. Often, after an area is dredged, scavengers move in rapidly and eat broken clams and soft-bodied organisms that are removed from the substrate. However, the panel considered that evidence for effects on infaunal prey organisms was weak because there aren't many studies that link changes in benthic community structure in dredged areas to the food supply for fish, and those that do exist do not show definitive results. The panel concluded that infaunal communities would be likely to recover more quickly than emergent epifauna, and therefore removal of structure-forming organisms was judged to be more of a concern. However, one panelist noted that the potential loss of secondary production of benthic invertebrates which are prey for bottom-feeding fish is the effect that is least understood, and that any reduction in prey abundance – if it occurs – would not necessarily be limited to the dredge tracks themselves, but would affect the entire dredged area. Moreover, the effects of fluidizing the sediment on benthic infauna are unknown and may be important.

The panel noted that there may be cumulative physical and biological effects in areas that are dredged several times annually. As previously stated, surfclams grow much more rapidly than ocean quahogs and surfclam beds are dredged every few years, whereas areas dredged for ocean quahogs are left untouched for many years. It was also noted that benthic organisms that occupy muddy bottom in deep water are less adapted to physical disturbance and therefore would presumably take longer to recover from dredging than organisms in sandy bottom areas in shallower water.

The panel concluded that the habitat effects of hydraulic dredging were limited to sandy substrates, since the gear is not used in gravel and mud habitats (Table 3). Two effects -changes in physical and biological structure – were determined to occur at high levels. The evidence cited for these two effects was a combination of peer-reviewed scientific literature, gray literature, and professional judgement. There are no effects of hydraulic dredges on major physical features in sandy habitat because, in the panel's view, there are no such features on sandy bottom. Panel members evaluated changes to benthic prey as unknown.

The temporal scale of the effects varies depending on the background energy of the environment. Recovery of physical structure can range from days in high energy environments to months in low energy environments, whereas biological structure can take months to years to recover from dredging, depending on what species are affected.

The panel agreed that hydraulic dredges have important habitat effects, but even in a worse case scenario, where there were known to be severe biological impacts, only a small area is affected and therefore this gear type is less important than other gear types like bottom trawls and scallop dredges which affect much larger areas. It was also pointed out, however, that even though the effects of dredging (at least for surfclams) are limited to a relatively small area, localized effects of dredging on EFH could be very significant if the dredged area is a productive habitat for one or more managed fish resources. The same would be true if dredging in a particular area coincided with a strong settlement of larval fish. A major question for this gear is "what are its long-term biological impacts" *i.e.*, how, and to what extent, are benthic communities altered in heavily dredged areas, particularly the prey organisms, and how long does it take for them to recover once dredging ceases?

The Council concurs with the fishing gear workshop panel in that there may be some impacts but that they are short term and minimal.

### 7.4.5.2 Impacts of clam dredges to EFH of other Federally managed species and the vulnerability of that EFH to bottom-tending fishing gear

There is minimal bycatch in the surfclam and ocean quahog fisheries (section 3.1.9 of Amendment 13). From the 1997 NEFSC clam survey species listing (Table 34 of Amendment 13), surfclams and ocean quahogs comprise well over 80% of the total caught in the scientific survey. Commercial operations are certainly even cleaner than the scientific surveys (as the surveys use liners to collect all animals), as all animate and inanimate objects except for surfclams and ocean quahogs are discarded quickly before the resource is placed in the cages. The processors reduce their payments if "things" other than surfclams or ocean quahogs are in the cages.

Given that: (1) MacKenzie (1982) showed not pattern of any relationship of numbers of species or their abundance and the amount of dredging that had occurred, (2) that these fisheries are ITQ fisheries and as such there was not reason for fishermen to "rush to fish", (3) that the number of vessels has significantly decreased from 168 to less than 50 vessels during the ITQ decade and (4) that abiotic waves are formed frequently during high storm events as deep as 200 to 250 feet (Auster and Langton 1998), the Council proposes no specific management measures at this time. The Council will solicited public input on clam dredge gear impact during the public hearing process. The Council concurs with the 2001 Boston fishing gear impacts workshop that any impacts to EFH would be minimal and short-term, and thus they have concluded that there is not an adverse effect to other Federally managed species.

Two additional sources of evidence have just recently been received that also support the findings of the workshop and the concurrence of the Council. First, the National Research Council (2002) just completed a report entitled *Effects of Trawling and Dredging on Seafloor Habitat.* In addition, the Council's former Executive Director John Bryson also provided some personal thoughts from observations from the Johnson Sea Link submersible. Bryson (pers. comm.) reported that the substrate where clams are harvested tends to resettle quickly and in many areas this can be minutes not days. He also reports that he did not observe the large sediment cloud nor the deep track some authors report.

The NRC report upon review of what the Regional Council's did to address fishing gear impacts after SFA in 1996 stated: "The regional councils found it difficult to develop criteria for designating EFH due to gaps in existing knowledge on the distribution of benthic life stages of fishes and other species and the physical and biological characteristics of the seafloor. Similarly, the councils struggled with the requirement to assess the effects of bottom trawling and dredging because they had insufficient data on the spatial scale and extent of bottom fishing effort and lacked guidelines for generalizing the results of research on specific gears and habitats. These problems relate to the committee's task to recommend ways for using existing information in the management of the habitat effects of trawl and dredge fisheries."

The report continues: "A complete assessment of the ecosystem effects of trawling and dredging requires three types of information:

1) gear-specific effects on different habitat types (obtained experimentally);

2) the frequency and geographic distribution of bottom tows (trawl and dredge fishing effort data);
3) the physical and biological characteristics of seafloor habitats in the fishing grounds (seafloor mapping).

The NRC (2002) report summarizes the currently available data in the above three areas and describes how the low spatial resolution and availability of the fishing effort and habitat mapping data restrict a full evaluation of the ecosystem effects of trawling and dredging. The report concludes that in less consolidated coarse sediments in areas of high natural disturbance there are few initial effects. The report also states that since the 1990s there were significant reductions in the intensity and spatial extend of bottom fishing. Finally, the report also states that for most areas only coarse maps are available on habitat distribution. The conclusion is that: "existing data are not sufficient for optimizing the spatial and temporal distribution of trawling and dredging to protect habitat and sustain fishery yields. Resolution of the different, and at times conflicting, ecological and socioeconomic goals will require not only a better understanding of the relevant ecosystems and fisheries, but also more effective interaction among stakeholders."

Just about all the species managed by the Mid-Atlantic Council, New England Council, South Atlantic Council and NMFS – Highly Migratory Species, have EFH that overlap with the EFH of surfclams and ocean quahogs. Any actions implemented in this FMP that affect the other species that have overlapping EFH with surfclams and ocean quahogs will be considered in the EFH assessment of this quota recommendation package.

The purpose of this section is to evaluate potential adverse effects of bottom-tending fishing gears regulated by the Magnuson-Stevens Act (MSA) on benthic EFH in the Northeast region of the U.S. as required by the EFH final rule, 50 CFR 600.815(a)(2)(I). The EFH final rule recommends that the evaluation consider the effects of each fishing activity on each type of habitat found within the EFH for any affected species and life stage. The EFH rule further recommends that the following information be reviewed in making an evaluation: intensity, extent, and frequency of any adverse effects on EFH; the types of habitat within EFH that may be adversely affected; habitat functions that may be disturbed; and conclusions regarding whether and how each fishing activity adversely affects EFH.

The EFH final rule requires that EFH designations be based upon the best available information. This information may fall into four categories that range from the least specific (Level 1) to the most specific (Level 4). These categories are defined as follows:

<u>Level 1</u>: Presence/absence data are available to describe the distribution of a species (or life history stage) in relation to potential habitats for portions of its range.

<u>Level 2</u>: Quantitative data (*i.e.*, density or relative abundance) are available for the habitats occupied by a species or life history stage.

<u>Level 3</u>: Data are available on habitat-related growth, reproduction, and/or survival by life history stage.

<u>Level 4</u>: Data are available that directly relate the production rates of a species or life history stage to habitat type, quantity, and location.

Existing EFH designations in the Northeast region are based primarily on Level 2 information. This level of information is inadequate for making definitive determinations of the consequences of fishing-related habitat alterations on EFH for any species or life stage in the Northeast region because the habitat alterations caused by fishing can not be linked to any known effect on species productivity. This section of the report qualitatively evaluates the vulnerability of benthic EFH for each species and life history stage (eggs, larvae, juveniles, adults, and spawning adults) in the Northeast region that were determined by Stevenson *et al.* (in press) to be vulnerable to impacts from hydraulic clam dredges. Given the limited nature of the information available for this evaluation, emphasis was placed on the identification of potential adverse impacts of fishing on benthic EFH. Vulnerability is defined as the likelihood that the functional value of EFH would be adversely affected as a result of fishing.

The information that Stevenson *et al.* (in press) used to perform these evaluations included: 1) the EFH designations adopted by the Mid-Atlantic, New England, and South Atlantic Fishery Management Councils; 2) the results of a Fishing Gear Effects Workshop convened in October 2001; 3) the information provided in this report, including the results of existing scientific studies, and the geographic distribution of hydraulic clam dredge use in the Northeast region; and 4) the habitats utilized by each species and life stage as indicated in their EFH designations and supplemented by other references. First, the habitat's value to each species and life stage was characterized to the extent possible, based on its function in providing shelter, food and/or the right conditions for reproduction. For example, if the habitat provided shelter from predators for juvenile or other life stages, gear impacts that could reduce shelter were of greater concern. In cases where a food source was closely associated with the benthos (*e.g.* infauna), the ability of a species to use alternative food sources was evaluated. Additionally, since benthic prey populations may also be adversely affected by fishing, gear impacts that could affect the availability of prey for bottom-feeding species or life stages were of greater concern than if the species or life stages were piscivorous. In most cases habitat usage was determined from the information provided in the EFH Source Documents (NOAA Technical Memorandum NMFS-NE issues 123-153) with additional information from Collette and Klein-MacPhee (2002).

Based upon this qualitative draft assessment approach (Stevenson *et al.* in press) of the above information the following species and life stages have been determined (Stevenson *et al.* in press) to have EFH that may be vulnerable to impacts from hydraulic clam dredges:

Black sea bass (juveniles and adults), scup (juveniles), ocean pout (all life stages), red hake (juveniles), silver hake (juveniles), winter flounder (juveniles and adults), and Atlantic sea scallops (juveniles). The rationale for each determination is outlined below.

**Black sea bass** *(Centropristis striata)* are found in coastal waters of the northwest Atlantic, from Cape Cod south to Cape Canaveral (Collette and Klein-MacPhee 2002). Occasionally they stray as far north as the Bay of Fundy (Gulf of Maine). Juveniles are common in high salinity estuaries. Adults and juveniles are found in estuaries from Massachusetts south to the James River, VA (Stone *et al.* 1994).

Black sea bass larvae are pelagic, but then become demersal and occupy structured inshore habitat such as sponge beds, eelgrass beds, shellfish beds, shell patches, and other rough bottoms (Steimle *et al.* 1999) and offshore shell patches including clam beds (Able and Fahay 1998). The availability of structure limits successful postlarval and/or juvenile recruitment (Steimle *et al.* 1999). Juveniles are diurnal visual predators that feed on benthic invertebrates and small fish.

Adults are also structure oriented, and thought to use structure as shelter during day- time, but may stray off it to hunt at night.

Each of these life stages is associated with structure that may be vulnerable to mobile fishing gear impacts. However, it is important to note that structured habitats comprised of wrecks or other artificial reefs prone to damage by mobile gear may be avoided by hydraulic clam dredges. This is true of high relief natural areas as well. Black sea bass eggs are pelagic, so vulnerability to EFH is not applicable. Although larvae are pelagic, they do become demersal as they transition into juveniles so larval EFH is also vulnerable to mobile gear.

**Scup** *(Stenotomus chrysops)* is a temperate species that occurs primarily from Massachusetts to South Carolina, although it has been reported as far north as the Bay of Fundy and Sable Island Bank, Canada (Steimle *et al.* 1999). Scup are primarily benthic feeders that use a variety of habitat types. Juveniles forage on epibenthic amphipods, other small crustaceans, polychaetes, mollusks, fish eggs, and larvae. They occur over a variety of substrates, and are most abundant in areas without structure. Limited observations of scup have shown periodic use of seafloor depressions for cover (Auster *et al.* 1991 and 1995).

Adults are found on soft bottoms or near structures. During the summer they are closer inshore and found on a wider range of habitats. In the winter they congregate offshore in areas that are expected to serve as a thermal refuge (Collette and Klein-McPhee 2002), particularly deeper waters of the outer continental shelf and around canyon heads. Smaller adults feed on echinoderms, annelids, and small crustaceans. Larger scup consume more squids and fishes. Since juvenile scup are primarily benthic feeders, their EFH is considered vulnerable to impacts from mobile bottom gear. EFH vulnerability for adults is minimal since there is less of a reliance on benthic prey items.

**Ocean pout** (*Zoarces americanus*) is a demersal species found in the western Atlantic from Labrador south to Cape Hatteras (Steimle *et al.* 1999e). It can occur in deeper waters south of Cape Hatteras, and has been found as deep as 1000 feet (Collette and Klein-MacPhee 2002). It is found in most estuaries and embayments in the Gulf of Maine, and is caught in greatest abundance by the NEFSC trawl survey off southern New England (Steimle *et al.* 1999).

Ocean pout eggs are laid in nests in crevices, on hard bottom or in holes and protected by the female parent for 2.5 to 3 months until they hatch (Collette and Klein-MacPhee 2002). Potential impacts to habitat from otter trawls, scallop dredges and clam dredges include knocking down boulder piles, removing biogenic structure and filling in bottom depressions, which may disturb nests and/or leave these areas less suitable for nests. In addition, fishing may frighten parents from nests leaving eggs susceptible to predation. Egg EFH is therefore considered to be vulnerable to all bottom-tending mobile gear.

Ocean pout have a relatively short larval stage, and in fact some authors (Collette and Klein-MacPhee 2002) suggest that there is no larval stage (Steimle *et al.* 1999). Since the NEFMC designated EFH for this life stage, it is considered here as a distinct life stage. Larvae (hatchlings) remain near the nest site; however, there is little information on their use of habitats. Larvae do not appear to be as closely associated with the bottom as eggs or juveniles; however, it is anticipated that loss of structure may impact larvae to some degree. Larval EFH is considered vulnerable to mobile bottom-tending gears.

Juvenile pout are found under rocks, shells and algae, in coastal waters and are closely associated with the bottom (Steimle *et al.* 1999). They feed on benthic invertebrates such as gammarid amphipods and polychaetes. It is expected that loss of structure may be a fairly significant impact to juvenile EFH. Juvenile EFH is considered vulnerable to all mobile gear.

Adult pout are found in sand and gravel in winter and spring, and in rocky/hard substrate areas for spawning and nesting (Collette and Klein-MacPhee 2002). They create burrows in soft sediments, and their diet consists mainly of benthic invertebrates including mollusks, crustaceans and echinoderms. Because of the strong benthic affinity of ocean pout, it is anticipated that adult EFH is vulnerable to all mobile gear.

**Red hake** (*Urophycis chuss*) is a demersal species that ranges from southern Newfoundland to North Carolina, and is most abundant between Georges Bank and New Jersey (Steimle *et al.* 1999). They occur at depths between 100 and 3000 feet, and are most common between 225 and 375 feet (Collette and Klein-MacPhee 2002). Larvae, juveniles, and adults have been found in estuaries from Maine south to Chesapeake Bay. Eggs and larvae are pelagic, and EFH vulnerability to bottom-tending fishing gear is not applicable.

Juvenile red hake are found in live Atlantic sea scallops or empty scallop shells, and are also associated with other objects such as other shells, sponges, and rocks (Collette and Klein-MacPhee 2002). Shelter appears to be a critical habitat requirement for this life stage (Able and Fahay 1998), and physical complexity, including biogenic structure other than scallop shells, may be important (Auster *et al.* 1991 and 1995). Their diet consists mainly of amphipods and other infauna and epifauna. Juvenile hake EFH is considered to be vulnerable to all three mobile gear groups.

Adult red hake feed mainly on euphausiids, and also consume other invertebrates and fish (Collette and Klein-MacPhee 2002). They are found mainly on soft bottoms (sand and mud) where they create depressions or use existing depressions. They are also found on shell beds, but not on open, sandy bottom. Offshore in Maryland and northern Virginia, adult red hake are found on temperate reefs and hard bottom areas. Clam dredges would not typically operate in these hard bottom areas, nor in the softer sediments with which red hake are usually associated in the northern extent of their range, but there is some overlap between adult EFH and clam dredge use in sandy habitats. Therefore, there is some EFH vulnerability to clam dredges.

**Whiting or silver hake** *(Merluccius bilinearis)* range from Newfoundland south to Cape Fear, NC, and are most common from Nova Scotia to New Jersey (Morse *et al.* 1999). They are distributed broadly, and are found from nearshore shallows out to a depth of 1200 feet (Collette and Klein-MacPhee 2002). All life stages have been found in estuaries from Maine to Cape Cod Bay (Morse *et al.* 1999). The vertical movement of offshore hake is governed chiefly by their pursuit of prey; both juveniles and adults show a vertical migration off the bottom at night when feeding activity is greatest.

In the mid-Atlantic Bight, juvenile whiting have been found in greater densities in areas with greater amphipod tube cover (Auster *et al.* 1997). Further, silver hake size distributions in sand wave habitats are positively correlated with sand wave period (*i.e.*, the spacing between sand waves), suggesting energetic or prey capture benefits in particular sand wave environments (Auster *et al* in press). Juveniles are primarily found on silt or sand substrate and feed mainly on crustaceans, including copepods, amphipods, euphausiids, and decapods (Morse *et al.* 1999).

Juvenile EFH is considered vulnerable to mobile gear because of the potential connection between structure and habitat suitability for this life stage.

Adult whiting rest on the bottom in depressions by day, primarily over sand and pebble bottoms, and rarely in rockier areas. In the mid-Atlantic, adults were found on flat sand, sand wave crests, shell, and biogenic depressions, but were most often found on flat sand. At night, adults feed on anchovies, herring, lanternfish, and other fishes (Collette and Klein-MacPhee 2002). Piscivory increases with size for this species. Vulnerability of adult whiting EFH to the three mobile gear types is considered minimal because of whitings piscivorous food habits and preference for higher energy sand environments which recover quickly from fishing gear impacts. Eggs and larvae of this species are pelagic, so habitat vulnerability to fishing gear is not applicable.

**Winter flounder** *(Pseudopleuronectes americanus)* range from Labrador to Georgia, and are most abundant from the Gulf of St. Lawrence to Chesapeake Bay (Collette and Klein-MacPhee 2002). All life stages are common in estuaries from Maine through Chesapeake Bay. Juveniles and adults are found in waters less than 300 feet deep, and most are found from shore to 100 feet. They range far upstream in estuaries, and have been found in freshwater.

Winter flounder lay demersal adhesive eggs in shallow water less than 15 feet in depth, with the exception of spawning areas on Georges Bank and Nantucket shoals (Pereira *et al.* 1999). Substrates include sand, muddy sand, mud and gravel, with sand the most common. Although otter trawls, scallop dredges and clam dredges may affect the eggs directly, this was not considered a habitat impact. Since there is no indication that the eggs rely on any structure, egg EFH vulnerability to these three gears is considered minimal. Since early stage larvae are associated with the bottom and are at times demersal (Able and Fahay 1998) larval EFH may also have minimal vulnerability to all gears.

Juvenile and adult winter flounder are found on mud and sand substrates, and adults are also seen on cobble, rocks and boulders (Pereira *et al.* 1999). Both life stages can be opportunistic feeders, however their main prey items are infaunal invertebrates. Because of their reliance on infauna and their ability to use alternative food supplies, EFH is considered vulnerable to the three mobile gear types for these life stages.

**Atlantic sea scallops** (*Placopecten magellanicus*) are found on the continental shelf of the northwest Atlantic, from the Gulf of St. Lawrence south to Cape Hatteras (Packer *et al.* 1999). Benthic life stages occur at depths from shore out to approximately 325 feet. Larvae are pelagic, and EFH vulnerability to fishing gear impacts is not applicable.

Scallop eggs are heavier than seawater and are thought to remain on the bottom during development, but the functional value of this habitat for eggs is unknown. EFH vulnerability for eggs is considered minimal for all mobile gear types. Early juvenile scallops or spat (described as late stage larvae in the EFH descriptions) settle in areas of gravelly sand with shell fragments (Packer *et al.* 1999). Larsen and Lee (1978) indicated that spat may obtain a survival advantage in areas of increased structure, including sessile branching plants and animals. The availability of suitable hard surfaces on which to settle appears to be a primary requirement for successful reproduction (Packer *et al.* 1999). There is a close association between the bryozoan, *Eucratea loricata*, and spat. *Eucratea* attach to adult scallops, and have been found to contain large numbers of spat (Packer *et al.* 1999). Juvenile scallops (spat) are very delicate and do not survive on shifting sand bottoms (Packer *et al.* 1999). Since otter trawls, scallop dredges and hydraulic clam dredges can reduce the amount of benthic structure important to survival, juvenile scallop EFH is considered vulnerable to mobile benthic gears.

Adults are found in benthic habitats with some water movement, which is critical for feeding, oxygen and removal of waste; optimal growth for adults occurs at currents of 4 inches/sec (Packer *et al.* 1999). Adult scallops inhabit coarse substrates, usually gravel, shell, and rocks. They are less likely to be found in areas with fine clay particles. No scientific information exists that indicates mobile fishing gear has a negative impact on the functional value of adult scallop EFH. The vulnerability of adult scallop EFH to mobile benthic gears is therefore considered minimal.

#### 7.4.6 Other species

Any species that could potentially be impacted by this FMP is considered part of the affected environment. General faunal assemblages specific to north and mid-Atlantic habitat types are described in Appendix 3. Species potentially impacted by this FMP can be described through predator/prey relationships, species with overlapping EFH, bycatch species of these fisheries, and marine mammals, sea turtles, and seabirds.

#### 7.4.6.1 Predator/prey and other ecological relationships

Species that are in predator/prey and other ecological relationships with surfclams and ocean quahogs are fully described in section 2.1.3.

#### 7.4.6.2 Bycatch

An analysis of bycatch is one way of determining other species that could be affected by this FMP. Amendment 13 includes a detailed description of the minimal bycatch of these fisheries.

#### 7.4.6.3 Marine mammals, sea turtles, and seabirds

Marine mammals, sea turtles, and seabirds that could have interactions with surfclam and ocean quahog fisheries are fully described in section 3.3. Any impacts that the management alternatives could have on these species are described in section 3.3, where applicable.

### 7.5 Alternatives for Managing Adverse Effects from Fishing

According to section 600.815 (a)(2), fishery management options may include, but are not limited to: (A) fishing equipment restrictions, (B) time/area closures, and ©) harvest limits.

According to section 600.815(a)(2)(ii) that deals with minimizing adverse effects: Each FMP must minimize to the extent practicable adverse effects from fishing on EFH, including EFH designated under other Federal FMPs. Councils must act to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable, if there is evidence that a fishing activity adversely affects EFH in a manner that is more than minimal and not temporary in nature, based on the evaluation conducted pursuant to paragraph (a)(2)(I) of this section and/or the cumulative impacts analysis conducted pursuant to paragraph (a)(5) of this section. In such cases, FMPs should identify a range of potential new actions that could be taken to address adverse effects on EFH, include an analysis of the practicability of potential new actions, and adopt any new measures that are necessary and practicable. amendments to the FMP or to its implementing regulations must ensure that the FMP continues to minimize[4] to the extent practicable adverse effects on EFH caused by fishing. FMPs must explain the reasons for the Council's conclusions regarding the past and/or new actions that minimize to the extent practicable the adverse effects of fishing on EFH.

Section 600.815(a)(2)(iii) defines the issue of practicability. In determining whether it is practicable to minimize an adverse effect from fishing, Councils should consider the nature and extent of the adverse effect on EFH and the long and short-term costs and benefits of potential management measures to EFH, associated fisheries, and the nation, consistent with National Standard 7. In determining whether management measures are practicable, Councils are not required to perform a formal cost/benefit analysis.

The Council assumed the panel of experts assembled at the fishing gear workshop in October 2001 provided the best synthesis of the existing scientific knowledge and the best management recommendations. The workshop panel concluded that the habitat effects of hydraulic dredging were limited to sandy substrates, since the gear is not used in gravel and mud habitats (Table 3). Two effects -changes in physical and biological structure – were determined to occur at high levels. The evidence cited for these two effects was a combination of peer-reviewed scientific literature, gray literature, and professional judgement. There are no effects of hydraulic dredges on major physical features in sandy habitat because, in the panel's view, there are no such features on sandy bottom. Panel members evaluated changes to benthic prey as unknown.

Dr. William DuPaul (VIMS) led the discussion at the fishing gear impacts workshop on the types of management actions that could be taken to minimize adverse impacts of hydraulic dredging to benthic habitat. The following two paragraphs are taken from that report (Appendix 4).

The effectiveness of the Individual Transferable Quota (ITQ) management program since 1990 and the opinion that the two resources are underfished, led the panel to conclude that reductions in effort are probably not practicable. Nor is it likely that gear substitutions or modifications are practical since the current gear is highly efficient at harvesting clams. Therefore spatial area management seems to be the only practicable approach to minimizing gear impacts, if necessary.

It was emphasized that hydraulic dredges are designed to operate in sandy substrate. This gear could be very destructive if fished in the wrong sediment type or in structured environments like gravel beds or tilefish pueblo villages. The panel emphasized the gear should not be used in sediment types where it would cause more damage. Areas of known structure-forming biota should be mapped and set aside as a priority. It was emphasized that since we really do not know what the effect of this gear is to soft-bodied benthic organisms, a possible precautionary measure would be to restrict the fishery to areas of high clam productivity.

The temporal scale of the effects varies depending on the background energy of the environment. Recovery of physical structure can range from days in high energy environments to months in low energy environments, whereas biological structure can take months to years to recover from dredging, depending on what species are affected.

The workshop panel agreed that hydraulic dredges have important habitat effects, but even in a worse case scenario, where there were known to be severe biological impacts, only a small area is affected and therefore this gear type is less important than other gear types like bottom trawls and scallop dredges which affect much larger areas. It was also pointed out, however, that even though the effects of dredging (at least for surfclams) are limited to a relatively small area, localized effects of dredging on EFH could be very significant if the dredged area is a productive habitat for one or more managed fish resource. The same would be true if dredging in a particular area coincided with a strong settlement of larval fish. A major question for this gear that the panel asked was "what are its long-term biological impacts" *i.e.*, how, and to what extent, are benthic communities altered in heavily dredged areas, particularly the prey organisms, and how long does it take for them to recover once dredging ceases?

The Council concluded from the above identified workshop (Appendix 4 of Amendment 13) that there is sufficient information that clam dredges could have an effect on EFH if the gear is fished improperly or in the wrong sediment type. For example, hydraulic clam dredges would have a significant impact to a coral reef or an SAV bed if such gear were used in a stable, fragile, structured, environment like one of those environments. However, the clam resources are concentrated in high energy sandy sediment and the fishing gear has evolved over the past five decades to fish most efficiently in this type of sandy sediment. This evolution of the fishing gear has minimized the effect on fishery habitat (Wallace and Hoff in press). Natural events have more effect on the benthic community than this type of fishing gear since all of the fishing activity takes place in sandy shallow water. Chiarella *et al.* (2002) describing the October 2001 workshop concluded that hydraulic clam dredges were not a major concern relative to otter trawls and scallop dredges. All of the hydraulic clam dredging for an entire year, would impact about 100 square miles of bottom (Table 2 of Amendment 13). Putting this in context, this 100 square miles is roughly the area of one ten minute square, and there are over 1200 ten minute squares in the EEZ between Cape Hatteras and Georges Bank. Thus, it does not appear that either surfclam or ocean quahog EFH is effected by fishing gear.

A qualitative EFH vulnerability analysis conducted by Stevenson *et al.* (in press) suggests that the EFH of several species may be vulnerable to impacts associated with the use of hydraulic clam dredges. This includes black sea bass (juveniles and adults), scup (juveniles), ocean pout (all life stages), red hake (juveniles), silver hake (juveniles), winter flounder (juveniles and adults), and Atlantic sea scallops (juveniles). (See section 2.2.5.5.2 of Amendment 13 for more detail)

Based upon existing information the Council concluded that there may be potential adverse effects on EFH from the hydraulic clam dredge, but concurred with the workshop panel (Appendix 4). The panel concluded that as the clam fishery is currently prosecuted, in sand habitats, there are potentially large, localized impacts to biological and physical structure, however the recovery time is relatively short. Since the recovery time is relatively short (hours to months) the adverse impacts to this high energy environment can be considered temporary. The preamble to the EFH Final Rule (50 CFR Part 600) defines temporary impacts as those that are limited in duration and that allow the particular environment to recover without measurable impact. Since these impacts are potentially effecting a relatively small portion (approximately 100 square nautical miles) of the overall large uniform area of high energy sand along the continental shelf (approximately 54,900 square nautical miles) these adverse impacts can be considered minimal. Additionally, the 100 square nautical miles impact each year (approximately 1.5 ten minute squares of latitude and longitude) represents a small fraction of the total EFH of the above listed vulnerable EFH and species. The preamble of the EFH Final Rule defines minimal impacts as those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions.

Although the Council has concluded that the clam fishery has an adverse effect on EFH that is no more than minimal and temporary in nature, there is enough uncertainty to warrant the evaluation of other measures that may be taken in light of this uncertainty. Based upon guidance from the Assistant Administrator (January 22, 2001), if information is inconclusive, a NEPA analysis should examine alternatives that could be taken in the face of uncertainty. For NEPA purposes, the guidance from the Assistant Administrator stated that the analysis of alternatives needs to consider explicitly a range of management measures for minimizing potential adverse effects, and the practicability and consequences of adopting those measures. The advise from Dr. Hogarth continues: "In other words, if there is evidence that a fishing practice may be having an identifiable adverse effect on EFH, even if there is no conclusive proof of adverse effects, it is not sufficient to conclude *prima facie* that no new management measures are necessary without first conducting a reasonably detailed alternatives analysis."

The Council evaluated nine alternatives that focused mostly on closed areas. The fishing gear impacts workshop (Appendix 4 of Amendment 13) concluded that effort reductions (i.e. harvest limits) and gear modifications (i.e. restrictions) were not workable for this fishery and that if the clam dredges were found to have significant adverse effects on EFH, then spatial closures were the only viable alternative to mitigate the adverse effects of this fishing gear. Since surfclams are underfished and the annual quotas are actually being increased (Table 27 of Amendment 13), it seems to make little sense to restrict harvest limits for EFH reasons, however there is an alternative for analysis where the ocean quahog optimum yield range would be reduced to trade off against an increase in surfclam quota. Finally, seven potential closed area alternatives were identified. These closed areas are being considered to be closed to clam dredging for 5 years. The distribution of the surfclam and ocean quahog resources based on the 1999 survey are depicted in Figures 5 through 8 of Amendment 13. Landings of the two species in 2000 are shown in Figures 9 and 10 of Amendment 13.

Of the nine alternatives that the Council considered initially relative to fishing gear impacts to EFH, four were thoroughly evaluated for their biological, economic, and social impacts. The Council did not thoroughly evaluate alternatives 5, 7, 8, and 9 for social and economic impacts because they determined that these closures were not reasonable with all of the data uncertainties associated with each alternative. The Council eliminated alternative 4 for thorough evaluation because it is in shallow water and storm events are much more significant at causing sediment disturbances in those depths than is hydraulic clamming activity.

Under the current management regime, surfclams and ocean quahogs are well managed and certainly not near overfished. This indicates that a sustainable fishery is possible without creating additional measures to protect EFH, i.e., the measures that are currently in place are certainly sufficient to achieve a sustainable fishery.

Many MAFMC, NEFMC, SAFMC, and HMS FMPs for several overfished species include management actions that would effectively reduce gear impacts to bottom habitats by reducing the harvest of the managed species. This reduction in harvesting effort may indirectly benefit EFH by creating an overall reduction of disturbance by a gear type that impacts bottom habitats. Other management actions already in place should control redirection of effort into other bottom habitats. These proposed quotas for 2004 are identical for the 2003 Maine "mahogany" ocean quahogs, and have only slight increases in the surfclam and ocean quahog quota, and therefore should cause little change in any impacts. The action will have no more than minimal adverse effects on EFH in the context of the fishery as a whole, therefore an abbreviated consultation with

NMFS is necessary. Based upon the rationale provided above, the MAFMC has determined that this action minimizes, to the extent practicable, the adverse effects of fishing on EFH as required by section 303 (a) (7) of the Magnuson-Stevens Act.

## 8.0 LIST OF AGENCIES AND PERSONS CONSULTED

The proposed quota recommendations were submitted to the National Marine Fisheries Service (NMFS) by the Mid-Atlantic Fishery Management Council. The Council on June 25, 2003, unanimously (with RA abstaining) approved the staff recommendation for the 4.6% increase in surfclam quota, unanimously (with RA abstaining) approved the staff recommendation for the continuation of the suspension of the surfclam minimum size limit, unanimously (with RA abstaining) approved the staff recommendation for increasing the ocean quahog quota to5 million bushels, and unanimously (with RA abstaining) approved the staff recommendation for maintenance of the Maine ocean quahog quota at 100,000 bushels.

In preparing these recommendations, 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, Mid-Atlantic EFH Technical Committee, Northeast Region Steering Committee, MAFMC Habitat Committee, and MAFMC Habitat Advisory Panel.

## 9.0 LIST OF PREPARERS OF THE ENVIRONMENTAL ASSESSMENT

The majority of the environmental assessment was prepared by Dr. Thomas B. Hoff of the Mid-Atlantic Council staff and is significantly based on information provided by the Northeast Fisheries Science Center through the most recent two stock assessments for surfclams (USDC 1998a and 2000a) and ocean quahogs (USDC 1998b and 2000b). A new stock assessment was developed at the 37th SARC in June of 2003 for surfclams, but the information was not available for the Council in their deliberations. Nothing in the 37th SARC assessment significantly changed for surfclams which was relayed to the Council, they simply did not have the benefit of the full information since the assessment was not complete and presented to them until the August Council meeting. Clayton E. Heaton of Council staff worked extensively with the economic issues including the PREE of the EA and the RIR, as well as with the logbook data and their analyses. The economic analyses in section 4 of Amendment 13 which was used as background information was conducted by Drs. James Kirkley (VIMS), Rob Hicks (VIMS) and Ivar Strand (University of Maryland) under contract to the Council. The social analyses (section 5) and port and community description (section 2.3.3) of Amendment 13 which was also used as background information were conducted by a team of researchers from Rutgers University headed by Dr. Bonnie McCay under contract to the Council. The members of Dr. McCay's social team were: Doug Wilson, Teresa Johnson, Kevin St. Martin, Johnelle Lamarque, Eleanor Bochenek, and Giovani Graziosi. In addition NEFSC scientific personnel, Drs. James Wienberg, Paul Rago, Larry Jacobson, and Steve Murawski have worked extensively on the last four new stock assessments (two each on surfclams and ocean quahogs). Lou Chiarella, NERO, provided extensive help on the fishing gear impact section and was the individual mostly responsible for the fishing gear impacts workshop in Boston in October 2001. Both Susan W. Chinn and Susan A. Murphy, NERO, provided extensive guidance throughout the development of this package.

## 10.0 FINDINGS OF NO SIGNIFICANT ENVIRONMENTAL IMPACT

National Oceanic and Atmospheric Administration Order (NAO) 216-6 (revised May 20, 1999) provides nine criteria for determining the significance of the impacts of a final fishery management action. These criteria are discussed below:

***1. Can the final action be reasonably expected to jeopardize the sustainability of any target species that may be affected by the action?***

None of the final specifications for 2004 are expected to jeopardize the sustainability of any target species affected by the action. All of the final quota specifications under the preferred alternatives for each species are consistent with the FMP overfishing definitions. This action will protect the long-term sustainability of the surfclam and ocean quahog stocks.

***2. Can the final action be reasonably expected to allow substantial damage to the ocean and coastal habitats and/or EFH as defined under the Magnuson-Stevens Act and identified in FMPs?***

The area affected by the final specifications in the surfclam and ocean quahog fisheries has been identified as EFH for the above mentioned species as well as Northeast Multispecies; Atlantic Sea Scallop; Summer Flounder, Scup, and Black Sea Bass; Atlantic Mackerel, Squid, and Butterfish; Bluefish; Atlantic Billfish; and Atlantic Tunas, Swordfish and Shark Fishery Management Plans. The preferred alternatives for the final 2004 specifications will have no more than minimal adverse impact on EFH. Because the potential of minimal adverse impact on EFH is not substantial, NMFS conducted an abbreviated EFH consultation pursuant to 50 CFR 600.920(h) and prepared an EFH Assessment that incorporates all of the information required in 50 CFR 600.920(g)(2).

***3. Can the final action be reasonably expected to have a substantial adverse impact on public health or safety?***

The final action is not expected to have a substantial adverse impact on public health or safety. None of the measures alters the manner in which the industry conducts fishing activities for the target species, therefore, there is no change in fishing behavior that would affect safety. None of the measures has any impact on public health.

***4. Can the final action be reasonably expected to have an adverse impact on endangered or threatened species, marine mammals, or critical habitat of these species?***

The specifications for the 2004 ocean quahog and surfclam fishery are not expected to alter fishing methods or activities. Therefore, this action is not expected to affect endangered or threatened species or critical habitat in any manner not considered in previous consultations on the fisheries. It has been determined that fishing activities conducted under this final rule will have no adverse impacts on marine mammals. None of the measures alters fishing methods or activities.

***5. Can the final action be reasonably expected to result in cumulative adverse effects that could have a substantial effect on the target species or non-target species?***

The final action is not expected to result in cumulative effects on target or non-target species (section 6.6). The final 2004 specifications would increase the surfclam quota by 4.6 percent and the ocean quahog quota by 11.1% from the 2003 status quo level and maintain the status quo level for the 2004 Maine mahogany ocean quahog fishery. As such, the final measures are not expected to result in any cumulative effects on target or non-target species.

***6. Can the final action be reasonably expected to jeopardize the sustainability of any non-target species?***

The final action is not expected to jeopardize the sustainability of any non-target species. The final measures maintain the specifications for an additional year for the Maine mahogany quahogs and slightly increases the surf clam quota by 4.6 percent and the ocean quahog by 11.1 percent. The most recent assessment for surfclams (SAW 30) indicated that the resource is at a high level of biomass, is under-exploited, and can safely sustain increased harvests. The ocean quahog resource is not overfished and overfishing is not occurring. Based on advice from SAW 31 and the Council's recommendation, this action proposes to increase the ocean quahog quota for 2004 to 5.000 million bushels.

The surfclam and ocean quahog fisheries are extremely clean, as evidenced by the 1997 NEFSC clam survey species listing that is included in Amendment 13 (Table 34). 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. commercial operations are certainly even cleaner than the scientific surveys which have liners in the dredges, as all animate and inanimate objects except for surfclams and ocean quahogs are discarded quickly before the resource is placed in the cages. The processors reduce their payments if "things" other than surfclams or ocean quahogs are in the cages.

The only gear used for the surfclam and ocean quahog fisheries is clam dredges which are now included in the List of Fisheries for 2003 as a Category III fishery (50 CFR Part 229 -- Final Rule) for the taking of marine mammals by commercial fishing operations under Section 114 of the Marine Mammal Protection Act (MMPA) of 1972. Clam vessels dredge at very slow speeds and healthy animals should have no difficulty avoiding these vessels. As such, minimal interaction is expected between clam dredging gear and protected species. According to the List of Fisheries for 2003 there are no documented interactions/takes in this fishery.

***7. Can the final action be expected to have a substantial impact on biodiversity and ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?***

The final action is not expected to have a substantial impact on biodiversity and ecosystem function within the affected area because the final action measures merely continue for a year an existing category of vessel permit and modifies catch allowances. Relative to the new approach to fisheries management that is being discussed extensively, ecosystem management, a recent paper by Arnason (1998) suggests that an ITQs system offers a potentially fruitful approach to the problem of ecological fisheries management. All fish stocks and their associated fisheries are embedded in an ecosystem. Therefore, to obtain maximum economic benefits, fisheries management must take due account of the corresponding web of ecological interrelationships. Unfortunately, however, due to the inherent complexity of ecosystems and the scarcity of the relevant empirical information, sensible ecological fisheries management is very difficult to achieve in most cases. According to Arnason (1998) the great advantage of the ITQ regime is that it enlists market forces to bring about the optimal utilization of the ecology.

***8. Are significant social or economic impacts interrelated with significant natural or physical environmental effects?***

As discussed in Section 6.0 of this EA, the final specifications for 2004 are not expected to result in significant social or economic impacts, or significant natural or physical environmental effects not already analyzed. Therefore, there are no significant social or economic impacts interrelated with significant natural or physical environmental impacts.

***9. To what degree are the effects on the quality of the human environment expected to be highly controversial?***

The final measures maintain the specifications for an additional year for Maine mahogany ocean quahogs and slightly increase the surfclam quota by 4.6 percent and the ocean quahog quota by 11.1 percent. These quota increases will not be controversial and are strongly favored by the industry. Therefore, the measures contained in this action are not expected to be highly controversial.

Having reviewed the Environmental Assessment for the 2004 Surfclam and Ocean Quahog Fishing Quotas and the available information relating to the proposed action and the cumulative effects of the proposed actions, I have determined that there will be no significant environmental impact resulting from the action and that preparation of an environmental impact statement on the action is not required by Section 102(2)©) of the National Environmental Policy Act or its implementing regulations.

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Assistant Administrator for Fisheries, NOAA Date

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## 12.0 LIST OF ACRONYMS

| | |
|---|---|
| ASMFC | Atlantic States Marine Fisheries Commission |
| B | Biomass |
| CEQ | Council on Environmental Quality |
| EA | Environmental Assessment |
| EEZ | Exclusive Economic Zone |
| EFH | Essential Fish Habitat |
| EIS | Environmental Impact Statement |
| F | Fishing Mortality Rate |
| FR | Federal Register |
| FMP | Fishery Management Plan |
| IRFA | Initial Regulatory Flexibility Analysis |
| M | Natural Mortality Rate |
| MA | Mid-Atlantic |
| MAFMC | Mid-Atlantic Fishery Management Council |
| MRFSS | Marine Recreational Fisheries Statistical Survey |
| MSY | Maximum Sustainable Yield |
| mt | metric tons |
| NAO | National Oceanic and Atmospheric Administration Order |
| NEFSC | Northeast Fisheries Science Center |
| NE | New England |
| NEPA | National Environmental Policy Act |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| PRA | Paperwork Reduction Act |
| PREE | Preliminary Regulatory Economic Evaluation |
| RIR | Regulatory Impact Review |
| SARC | Stock Assessment Review Committee |
| SAW | Stock Assessment Workshop |
| SSB | Spawning Stock Biomass |
| SFA | Sustainable Fisheries Act |
| TAL | Total Allowable Landings |
| TL | Total Length |
| VTR | Vessel Trip Report |

# Other Applicable Laws

## 1.0 PAPERWORK 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 is not proposing measures under this regulatory action that will involve increased paper work and consideration under this Act.

## 2.0 RELEVANT FEDERAL RULES

This action will not duplicate, overlap, or conflict with any other Federal rules.

# Regulatory Impact Review / Initial Regulatory Flexibility Analysis

## 1.0 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 or regulation. The RIR is part of the process of preparing and reviewing FMPs and provides a comprehensive review of the changes in net economic benefits to society 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 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.

## 2.0. EVALUATION OF E.O. 12866 SIGNIFICANCE

If a proposed action is determined to be significant under E.O. 12866, the analysis undergoes further scrutiny by the Office of Management and Budget (OMB) to ensure that it meets the requirements of E.O. 12866 (NMFS 2000). A "significant regulatory action" means any regulatory action that is likely to result in a rule that meets any of the criteria discussed below.

**Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, local, or tribal governments or communities;**

The proposed rules will not have an annual effect on the economy of more than $100 million. Based on Federal logbook reports, the total exvessel value of the EEZ surfclam fishery was $28.9 million in 2002, the ocean quahog EEZ ITQ fishery was $20.7 million, and the Maine ocean quahog fishery in Federal waters was $2.9 million. Hence, with a total exvessel value of $52.5 million between the three fisheries, it is difficult to conceive of any regulation that the Federal government might issue which would have secondary or cumulative impacts that would exceed the $100 million impact threshold.

The rules proposed for 2004 would increase the surfclam quota in the EEZ by 4.6%, increase the ITQ ocean quahog quota 11.1%, and leave the quota for the Maine ocean quahog fishery unchanged. Assuming a typical value of $12.00 per bushel for surfclams, the 150,000 bushel increase in 2004 would have a gross exvessel value of $1.8 million. At $6.00 per bushel, the 500,000 bushel increase in the ITQ ocean quahog quota would have a value of $3.0 million. Combined, the two increases would total $4.8 million. Following the dockside product further through the processing sector will see value added such that there will be an additional small, positive impact on the economy, but it would not reach the $100 million threshold required for a "significant" impact.

The proposed actions are necessary to maintain the harvest of surfclams and ocean quahogs at sustainable levels. 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.

**Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;**

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 Atlantic surfclam or ocean quahog fisheries in the EEZ.

**Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof;**

The proposed actions will not impact entitlements, grants, user fees, or loan programs or the rights and obligations of their participants.

**Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.**

The proposed actions support and maintain the fisheries management program implemented by the Surfclam and Ocean quahog Fishery Management Plan and subsequent Amendments. The Individual Transferrable Quota system instituted in the fall of 1990 has been largely credited with successfully addressing the problems of overcapitalization and inefficiency inherent in many effort-based management systems. It has provided a high level of stability, efficiency, and improved profitability to the utilization of these resources. As such, 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 the Executive Order.

The benefits of a stable, ITQ management program are additionally evident from the absence of constant legal challenge, which many of the alternative management programs in the country have become subject to.

### 2.1. Significance Conclusion

Due to the lack of meeting any of the four criteria described above, it is determined that the proposed 2004 quotas for the surfclam and ocean quahog fisheries do not constitute a "significant" regulatory action.

## 3.0. DESCRIPTION OF MANAGEMENT OBJECTIVES

A description of the management objectives of the Surfclam and Ocean Quahog FMP are presented in the Environmental Assessment (EA) Section 1.3 "Management Objectives" of this document.

## 4.0. DESCRIPTION OF THE FISHERY

A description of the surfclam fishery is presented in EA Section 5.1.2 "Fisheries" and EA 5.1.3 "Economic and Social Environment." The ocean quahog ITQ fishery is discussed in the parallel sections EA 5.2.2. and EA 5.2.3. The small-scale Maine ocean quahog fishery is described in sections EA 5.3.2. and 5.3.3. Finally, a brief description of the processing sector is in section EA 4.4.

## 5.0. PROBLEM STATEMENT

The need for Federal regulation of fisheries has at its core the tendency for common property resources to become degraded through overuse, and the potential benefits to society dissipated. These issues were addressed in the surfclam and ocean quahog fisheries off the Atlantic coast through implementation of an Individual Transferable Quota (ITQ) management program in September of 1990. Industry participants benefit from a high degree of flexibility in their fishing operations, as government regulation is basically reduced to quota holders not exceeding their individual allowances. Industry members are free to trade quota amongst themselves as best suits their individual business needs. Costs to society are minimized and efficiency greatly enhanced when the use of effort limitation and closed seasons to limit total annual harvests can be avoided. These tools have the unfortunate side effect of overcapitalizing fisheries with unneeded vessels that are obliged to operate inefficiently, dramatically reducing the net income that a society might have earned from its fishery resources.

The surfclam and ocean quahog fisheries are two out of a handful of fisheries around the United States that have been able to successfully implement ITQ management programs, providing substantial benefits to fishery participants and the nation at large. A continuing task remains, however, in monitoring the status of these living resources and determining the maximum quantity that can be safely removed from them each year, without damaging their health or the health of the ecosystem in which they reside.

The information available to fishery managers and the public in making these annual quota decisions is incomplete and subject to uncertainty. Key biological information on life history and the actual numbers of these animals hidden beneath the waves must be estimated rather than known with certainty. Important information on the human side of the equation is also missing, including comprehensive data on the costs of harvest and processing, as well as estimates of the industry supply and demand functions at the exvessel, wholesale, and retail product levels.

Regardless, an extensive economic analysis was conducted using the available data as part of Amendment 13 (Draft) to the Atlantic Surfclam and Ocean Quahog Fishery Management Plan (MAFMC 2002c). Quantitative results of the analysis relative to different quota alternatives are presented in this document where applicable. Qualitative results and professional judgement are presented when quantitative information is unavailable.

Further information on the purpose and need for the annual quota specification process can be found in EA Section 1.2.

## 6.0. DESCRIPTION OF MANAGEMENT ALTERNATIVES

A detailed description of all management alternatives considered in the proposed rule is presented in EA Section 3. The following sections provide a brief overview.

## 6.1. Quotas for the ITQ Fisheries

| Proposed 2004 Quota Alternatives | | | |
|---|---|---|---|
| **Surfclams** | | | |
| | Description | Quota (bushels) | % Change from 2003 |
| Alt. S1 | Min. Allowable | 1.850 million | 43.1% Decrease |
| Alt. S2 | Slight Decrease (2002 quota) | 3.135 million | 3.5% Decrease |
| Alt. S3 | Status Quo | 3.250 million | No Change |
| Alt. S4 | Slight Increase (half-way to max) | 3.325 million | 2.3% Increase |
| Alt. S5** | Max. Allowable | 3.400 million | 4.6% Increase |
| | | | |
| **Ocean Quahogs** | | | |
| Alt. Q1 | Min. Allowable | 4.000 million | 11.1% Decrease |
| Alt. Q2 | Partial Reduction | 4.250 million | 5.6% Decrease |
| Alt. Q3 | Status Quo | 4.500 million | No Change |
| Alt. Q4** | Increase | 5.000 million | 11.1% Increase |
| Alt. Q5 | Max. Allowable | 6.000 million | 33.3% Increase |
| ** Council Recommendation | | | |

Five alternative quota levels were identified for consideration in each of the two fisheries. The Council's choice was bounded by minimum and maximum quota levels that are specified as the Optimum Yield (OY) range in the Surfclam and Ocean Quahog Fishery Management Plan, and may not be exceeded in either direction without an amendment to the Plan.

For each fishery, the quota alternatives numbered 1 and 5 correspond to the minimum and maximum allowable quotas specified in the current OY range:

Surfclams 1.850 million to 3.400 million bushels

Ocean Quahogs 4.000 million to 6.000 million bushels

Alternatives which would maintain the status quo are also included for each fishery, and correspond to Alternatives S3 for surfclams (3.250 million bushels) and Alternative Q3 for ocean quahogs (4.500 million bushels).

The remaining two alternatives proposed for ocean quahogs were intended to give the Council flexibility in adjusting the quota by moderate amounts in either direction. Alternative Q2 would decrease the quota by 5.6% to 4.250 million bushels, and Alternative Q4 would increase the quota by 11.1% to 5.000 million bushels. The actual ocean quahog harvests for the past two years have been significantly below their allowable levels: the 2001 harvest (3.691 mill. bu.) was 18% below the 4.500 million bushel quota, and the 2002 harvest (3.871 mill. bu.) was 14% below the 2002 quota. Harvests at these levels are not currently valid quota options because they lie below the minimum OY range point of 4 million bushels. In order to address this disparity, part of the reasoning behind the 4.250 million bushel alternative was that it allows the ocean quahog quota to move closer to the harvest level which industry actually utilized in recent years, but moderates the adjustment to a 5.6% change rather than the full 11.1% decrease represented by the minimum OY level.

The quota decision to be made in the surfclam fishery is surrounded by somewhat different circumstances. The Federal quota has already been increased a total of 27% over the past three years, after remaining constant for the prior six. Existing scientific advice states that the quota could be safely increased further without harming the resource, but that substantial increases are not recommended due to uncertainty in biomass estimates and future trends.

An analysis of the expected impacts of each alternative will be presented in RIR Section 7. After lengthy deliberation and opportunity for public comment, the Council voted to recommend a 4.6% increase in the surfclam quota to 3.400 million bushels in 2004, and an increase of 11.1% in the ocean quahog ITQ quota to 5.000 million bushels.

### 6.2. Quotas for the Maine Ocean Quahog Fishery

| Alternative 2004 Quotas for the Maine Quahog Fishery | | | |
|---|---|---|---|
| Alt. M1 | 50% of Max. Quota | 50,000 Maine Bu. | 50% Decrease |
| Alt. M2 | Status Quo less 2002 Quota Overage | 84,700 Maine Bu. | 18% Decrease |
| Alt. M3** | Max Allowable - Status Quo | 100,000 Maine Bu. | No Change |
| ** Council Recommendation | | | |

The Maine ocean quahog fishery is distinct in several key respects. First, it is a small-scale fishery that produces high-value product for the fresh, half-shell market. No formal scientific assessment has yet been completed which estimates the size of the local beds, or what would constitute sustainable harvest levels. Amendment 10 to the FMP defined a Maine ocean quahog management zone with a maximum annual quota of 100,000 Maine bushels, which may not be increased until a formal, peer-reviewed assessment of the zone is completed. The Maine quota is open to all vessels holding Maine ocean quahog permits, and is not subdivided into individual allocation shares. Finally, the Maine fishing grounds are actively monitored for PSP toxin, and have experienced closures in recent years.

Three alternative quotas were identified for the Maine ocean quahog fishery. Alternative M1 corresponds to a 50% reduction from the maximum allowable quota under the current management plan. Alternative M2 corresponds to the current quota less the 15,300 bushel quota overage that occurred in 2002. Finally, Alternative M3 would maintain the status quo quota at the maximum allowable level of 100,000 Maine bushels.

The Council recommends that the Maine ocean quahog quota for 2004 remain unchanged at the initial maximum quota of 100,000 Maine bushels (1 bushel = 1.2445 cubic feet).

Staff believes that the 2003 quota will be reached in the fall of 2003, and the Regional Administrator will be obliged to close the fishery, as she was in October of 2002. No quota closure occurred in 2001, largely because discovery of PSP toxin halted landings for a portion of the peak summer season, to the point where an overage of the annual quota was not forecast.

According to 50 CFR section 648.76 (2)(b)(iv): *The Regional Administrator will monitor the quota based on dealer reports and other available information and shall determine the date when the quota will be harvested. NMFS shall publish notification in the Federal Register advising the public that, effective upon a specific date, the Maine mahogany quahog quota has been harvested and notifying vessel and dealer permit holders that no Maine mahogany quahog quota is available for the remainder of the year.*

It must also be remembered that according to 50 CFR section 648.76 (2)(b)(iii): *All mahogany quahogs landed by vessels fishing in the Maine mahogany quahog zone for an individual allocation of quahogs under section 648,70 will be counted against the ocean quahog allocation for which the vessel is fishing.* In other words, even after the initial maximum quota of 100,000 Maine bushels is harvested from the Maine mahogany ocean quahog zone (north of $43^{o}50^{'}$), vessels could obtain/use ITQ allocation and continue to fish in this zone. It is anticipated that some Maine fishermen will again rent ITQ allocation after the 100,000 bushel quota is reached in 2003, as they have for the past several years.

Amendment 10 (MAFMC 1998) emphasized that there had been no comprehensive, systematic survey or assessment of the ocean quahog resource in eastern Maine. It also emphasized that a full stock assessment of the Maine resource should be a priority to ensure that this segment of the fishery would have a sustainable future. The initial maximum quota for the Maine zone was to remain in effect until a resource survey and assessment was completed. The agreement at the time of Amendment 10 was that the State of Maine was to initiate a survey once the initial maximum quota of 100,000 bushels became constraining.

The Council recommended that the Maine ocean quahog quota remain unchanged from the 2003 quota level at 100,000 Maine bu (35,240 hL) for 2004. No additional information on the impacts of the quahog quota is available at this time that would allow a more in-depth analysis of the stock and therefore allow the quota to be increased beyond the current maximum level of 100,000 Maine bu (35,240 hL). A scientific survey and assessment of the Maine resource was initiated by the State of Maine in 2002. Work has been halted temporarily due to a shortage of funding. Once the work is completed and peer reviewed, the assessment will be utilized to specify future quotas for the Maine harvest zone. From the information currently available, maintaining the quota at its current level for another year will not seriously constrain the fishery or endanger the resource.

### 6.3. Surfclam Size Limit Suspension

The Council recommends that the surfclam minimum size limit remain suspended in 2004. The minimum length for surfclams is 4.75 inches. According to 50 CFR section 648.72 ©): *Upon the recommendation of the MAFMC, the Regional Administrator may suspend annually, by publication in the Federal Register, the minimum shell-height standard, unless discard, catch, and survey data indicate that 30 percent of the surfclams are smaller than 4.75 inches (12.065 cm) and the overall reduced shell height is not attributable to beds where the growth of individual surfclams has been reduced because of density dependent factors.*

## 7. ANALYSIS OF ALTERNATIVES

The objective of this analysis is to describe clearly and concisely the economic effects of the various alternatives. The types of effects that should be considered include the following:

- Changes in net benefits within a benefit-cost framework.
- Changes in the distribution of benefits and costs among groups.
- Changes in income and employment in fishing communities.
- Cumulative impacts of regulations.

A more detailed description of the economic concepts involved can be found in "Guidelines for Economic Analysis of Fishery Management Actions" (NMFS 2000), as only a brief summary of key concepts will be presented here.

Benefit-cost analysis is conducted to evaluate the net social benefit arising from changes in consumer and producer surpluses that are expected to occur upon implementation of a regulatory action. Total Consumer Surplus (CS) is the difference between the amounts consumers are willing to pay for products or services and the amounts they actually pay. Thus CS represents net benefits to consumers. When the information necessary to plot the supply and demand curves for a particular commodity is available, consumer surplus is represented by the area that is below the demand curve and above the market clearing price where the two curves intersect. A substantial empirical analysis was conducted as part of Amendment 13 to the Surfclam and Ocean quahog FMP (MAFMC 2002c), which estimated changes in benefits and costs at two alternative levels of the surfclam quota. Where applicable, the results of that analysis will be included here. For those alternatives for which quantitative estimates are not available, a qualitative approach to the economic assessment was adopted.

An evaluation of consumer surplus for surfclams and ocean quahogs is further complicated by the fact that there are few retail markets for either species outside of Maine. All of the landings from the ITQ fisheries are sold to processors who then add value by processing them into a variety of product forms. Boxes of frozen, breaded surfclam strips, cans of "clamato" juice, or chopped "clam meats" are the more common items that may be found on retail grocer's shelves. The majority of production is sold at the wholesale level to restaurants or other processors in the food industry that use them as ingredients in chowders and sauces.

Net benefit to producers is producer surplus (PS). Total PS is the difference between the amounts producers actually receive for providing goods and services and the economic cost producers bear to do so. Graphically, it is the area above the supply curve and below the market clearing price where supply and demand intersect. Economic costs are measured by the opportunity cost of all resources including the raw materials, physical and human capital used in the process of supplying these goods and services to consumers.

One of the more visible costs to society of fisheries regulation is that of enforcement. From a budgetary perspective, the cost of enforcement is equivalent to the total public expenditure devoted to enforcement. However, the economic cost of enforcement is measured by the opportunity cost of devoting resources to enforcement vis à vis some other public or private use and/or by the opportunity cost of diverting enforcement resources from one fishery to another.

## 7.1. Analysis of Surfclam Alternatives

| **2004 Surfclam Quota Alternatives** | | | |
|---|---|---|---|
| | Description | Quota (bushels) | % Change from 2003 |
| Alt. S1 | Min. Allowable | 1.850 million | 43.1% Decrease |
| Alt. S2 | Slight Decrease (2002 quota) | 3.135 million | 3.5% Decrease |
| Alt. S3 | Status Quo | 3.250 million | No Change |
| Alt. S4 | Slight Increase (half-way to max) | 3.325 million | 2.3% Increase |
| Alt. S5** | Max. Allowable | 3.400 million | 4.6% Increase |
| ** Council Recommendation | | | |

## 7.1.1. Areas of Impact that Do Not Change Regardless of the Alternative

### *7.1.1.1. Harvest Costs (All alternatives)*

In specifying an annual quota for the Federal surfclam fishery, the government is placing a cap on total removals from the resource located in Federal waters. No companion regulations that would impact the type, quantity, or method of gear utilization in the fishery are in effect at this time. Adoption of ITQ management in the surfclam and ocean quahog fisheries has negated the need for most gear and effort regulations, which have the greatest impact on the efficiency and costs of harvest operations.

Allowing the industry to trade allocation among its members enables businesses to adjust capital, labor, and output to the levels that maximize profitability, and minimize costs.

The two remaining management tools in the FMP that have the potential to increase harvest costs directly are closed areas and the minimum size limit for surfclams. Closing nursery areas or creating "sanctuaries" to protect living resources and habitat in a specific area will typically oblige fishermen to limit their operations to areas which are less productive or more distant, thereby driving up costs.

Use of the surfclam minimum size restriction in the past has motivated vessels to install "sorters" which cull out smaller individuals and then route them back overboard. In addition to slowing the harvest process, sorters will add to the damage inflicted by dredging, resulting in substantial mortality to those small clams that are returned to the ocean.

Fortunately, recent assessment work has suggested that the overall health of the surfclam resource is better than it was thought to be in the mid-to late 1990's. This has allowed the Council to recommend increasing the quota again in 2004, and again forego the use of the two management tools which have the greatest negative side effects associated with them.

For these reasons, it is considered that none of the surfclam quota alternatives presented in this document will have the effect of significantly altering harvest costs.

### *7.1.1.2. Enforcement Costs (All alternatives)*

Adoption of ITQ management in the surfclam and ocean quahog fisheries has allowed enforcement officials to focus attention on a limited number of shoreside processing plants, as opposed to large expanses of the ocean to monitor effort restrictions. Instead of ensuring that vessels were operating only on their allowed fishing days, which required the use of expensive Coast Guard cutters and aircraft, enforcement officials can restrict their efforts to the accounting task of ensuring that all clam shipping containers bear an official government "tag." Once a tag is attached to a "cage" full of surfclams or ocean quahogs, it cannot be removed without destroying it. This prevents tags from being reused, and the annual quota from being exceeded.

Compliance with the regulations under the ITQ system is widely thought to be high. Perhaps the most significant reason for this is that the harvest rights represented by an allocation are valuable, and could be forfeit if repeated violations of the law are uncovered. This fact alone creates a situation where violators have much more to loose than gain by failing to place tags on a shipment of surfclams.

A second factor relates to the question of who is thought to be harmed by a violation. In a fishery managed as an open pool, violators may well feel they are only cheating "the government." In an ITQ managed fishery, the fishermen themselves are more highly vested in a fishery, and are more likely to view cheaters as stealing from themselves, rather than the government. Hence they are more likely to report violations they witness.

None of the management alternatives under consideration for surfclams would alter this enforcement dynamic, and therefore are not identified as leading to a change in enforcement costs.

### 7.1.2. Preferred Alternative S5 - Maximum Allowable Surfclam Quota - 3.400 million bushels

Increasing the surfclam quota by 4.6% to the maximum allowable by the current management plan was the staff recommendation to the Mid-Atlantic Council. After lengthy debate and consideration, the Council agreed to recommend a 4.6% increase for 2004.

#### *7.1.2.1. Landings*

Changing the surfclam quota to 3.400 million bushels in 2004 would represent a 4.6% increase in landings relative to the status quo.

#### *7.1.2.2. Exvessel Prices*

Demand for clam products increased steadily between 2000 and 2003, such that exvessel prices have been increasing in spite of the fact that the Federal quota has increased 27% over the same period. An economic analysis conducted in Amendment 13 estimated the changes in exvessel prices, revenue, consumer surplus, operating costs, producer surplus, and net benefits from changes in the annual quota (MAFMC 2002c Table 58). Potential quotas evaluated in the analysis included 3.135 million bushels, and 3.4 million bushels. Since two quota levels between these points were presented to the Council as alternatives for the 2004 fishing year, estimates were generated for the 3.25 and 3.325 million bushel quota levels from the surrounding values as follows.

| Economic Impacts of Proposed Essential Fish Habitat Regulations and New Surfclam Quotas<br>Excerpt and extrapolation from MAFMC 2002c Table 58. | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Surfclams** | | | | | | | |
| Quota/Landings | Trips | Price | Revenue | Consumer Surplus | Operating Costs | Producer Surplus | Net Benefits |
| 3.135 mill. bu. | 2,662 | 9.30 | 29,154,224 | 1,826,470 | 10,583,927 | 18,570,297 | 20,396,767 |
| *3.250 mill. bu. | 2,760 | 9.26 | 30,073,930 | 1,838,339 | 10,927,249 | 19,146,681 | 20,985,020 |
| *3.325 mill. bu. | 2,823 | 9.23 | 30,673,739 | 1,846,079 | 11,151,154 | 19,522,584 | 21,368,664 |
| 3.400 mill. bu. | 2,887 | 9.20 | 31,273,547 | 1,853,820 | 11,375,060 | 19,898,487 | 21,752,307 |
| * Estimate | | | | | | | |

Based on the above table, exvessel price would decline by $0.06 following an increase in quota from 3.250 million bushels to 3.400 million. However, it should be noted that surfclam prices in 2004 will also be influenced by changes in the available supply of surfclams from state waters, as well as changes in the supply of ocean quahogs, which can be used as a substitute source of clam meats in a number of products.

Surfclams are found in significant quantities in the state waters of New Jersey and New York. Historically, New Jersey has always been considered as having the largest surfclam resource in state waters. Over the past 8 years, the New Jersey quota for surfclams has ranged between 600,000 and 700,000 bushels. The quality of the New Jersey state resource was considered to be on par with that found in Federal waters off its shores.

By contrast, the surfclam resource in New York state waters was considered less plentiful and of a lower quality than that found in New Jersey and Federal waters. Substantial portions of the 500,000 bushel annual quota were left unharvested in the late 1990s, as the industry chose to utilize surfclams from other areas which provided clams with a higher meat yield.

In 2003 we now see that a dramatic reversal of fortune has been occurring in the two states over the past 3 years. Perhaps due to an increase in seawater temperature, the surfclam biomass in New Jersey state waters is estimated to have declined by 74% between 1999 and 2002. Annual surveys have detected very little recruitment of small surfclams. Both fishermen and State officials are very concerned about these events, and it is considered likely that the State will feel obliged to reduce the quota for the upcoming season to the minimum allowed by law, or 250,000 bushels.

Conversely, the biomass of the New York resource is estimated to have increased slightly from 12.2 million bushels in 1999 to 12.8 million bushels in 2002. Again, researchers are theorizing that warmer seawater temperatures may have shifted the optimal habitat for surfclams northward (toward New York), and stressed populations in the warmest locations (southern and inshore areas). Fleet activity in New York waters has increased correspondingly, such that it is anticipated that the 500,000 bushel quota will be fully harvested in 2003. While it is possible that the New York quota will be increased at some point in the future, an increase is not expected for the 2004 fishing year.

The expectation for surfclam supply in 2004 then, is that the recommended 150,000 bushel increase in the Federal quota will not offset the expected 350,000 bushel decline in the New Jersey state quota, leaving a net reduction of 200,000 bushels coastwide. The Council took this into consideration when recommending a significant increase in the ocean quahog quota of 500,000 bushels. On balance, it is expected that average surflclam exvessel prices will edge higher in 2004. However, it should be noted that adoption of this alternative would reduce pricing pressure slightly when compared to the status quo.

### *7.1.2.3. Consumer Prices*

It is expected that some portion of an increase in exvessel prices would be passed along to consumers. The most noticeable cases would be in those products which contain a high proportion of surfclam meat. Note that the magnitude of such an increase would be less than would occur if the status quo were maintained in 2004.

### *7.1.2.4. Consumer Surplus*

Consumer surplus is expected to be larger under this alternative than the status quo, as consumers will be able to purchase 4.6% more surfclam product at prices lower than under the status quo. An estimate based on the Amendment 13 analysis indicates that consumer surplus would increase by $15,481 (MAFMC 2002c Table 58).

Note that the major changes in the surfclam market since 1997 are likely to be the result of actual shifts in the industry demand curve, rather than movements along the curve. The curve moved inward in 1997 and 1998 as interest shifted away from higher-priced surfclam-based products, and more toward lower-priced ocean quahog products. This market contraction lasted until 1999, when producers started introducing new products ("super-strips" and soup brands) with new advertising campaigns. These efforts were largely successful in rekindling consumer interest, to the extent that demand has shifted back to the right, with consumers purchasing larger quantities of surfclam products across multiple price points.

### *7.1.2.5. Producer Surplus*

An estimate based on the Amendment 13 analysis indicates that producer surplus would increase by $751,806 from increasing the Federal surfclam quota from 3.250 to 3.400 million bushels (MAFMC 2002c Table 58). With surfclam meat supplies remaining tight, it is likely that producers would receive the benefits of selling the additional quota, while still obtaining a modestly higher price for their catch.

#### *7.1.2.6. Distributive Impacts*

Given that a quota increase would impact all allocation holders proportionally, and that all of the increase could be sold, it is not considered that this alternative would disproportionally advantage or disadvantage any particular sector.

#### *7.1.2.7. Cumulative Impacts Over Time*

There are no obvious negative impacts that would accumulate over time following adoption of this alternative. Its primary objective was to allow for modest growth of the fishery while maintaining a conservative posture on removals from the stock until it is verified that such levels are sustainable.

Fishery managers are constantly faced with making management decisions with incomplete information. Professional judgement must be exercised in weighing the risks of over-harvesting a resource, which would reduce the amount of future rents generated, versus under-harvesting a resource, which would needlessly forego near-term benefits. For those species managed by the Mid-Atlantic Fishery Management Council, such decisions are reviewed and adjusted on an annual basis. Hence, course corrections can be made in fairly short order if new information suggests that quotas could be increased, or should be lowered.

#### *7.1.2.8. Risk of Biological Overexploitation*

The risk of biological overexploitation from a 4.6% increase in the surfclam quota is thought to be small, though it must be considered slightly higher than the status quo. The best scientific information currently available suggests that an annual quota of 3.400 million bushels should be sustainable over time. The major area of concern for the stock is the recent decline in biomass in the southern and inshore areas, perhaps due to an increase in average seawater temperature.

### 7.1.3. Alternative S1 - Minimum Allowable Surfclam Quota - 1.850 million bushels

#### *7.1.3.1. Landings*

Changing the surfclam quota to the minimum allowable under the existing management plan represents a 43.1% reduction in landings relative to the status quo.

#### *7.1.3.2. Exvessel Prices*

A 43.1% decrease in landings from Federal waters would have a significant impact on the market, and would most certainly lead to an increase in exvessel prices.

#### *7.1.3.3. Consumer Prices*

It is likely that some of the increase in exvessel price will be passed along to consumers. Those products that contain a high proportion of surfclam meat, such as the new fried clam "super-strips," would probably increase the most. Chowders and soups would likely be less affected.

#### *7.1.3.4. Consumer Surplus*

The consumer price increases that would result from adoption of this alternative would lead to a decrease in consumer surplus.

#### *7.1.3.5. Producer Surplus*

The benefits to the harvesting sector of higher exvessel prices would be offset by the 43.1% decrease in Federal surfclam harvests that could be sold. Whether a net increase or decrease in producer surplus would result depends on the magnitude of the exvessel price increase. In this analysis, it is assumed that the price increase would not fully compensate for the lost harvest opportunity, and result in a reduction in producer surplus.

#### *7.1.3.6. Distributive Impacts*

Given that a quota reduction would impact all allocation holders proportionally, it is not considered that this alternative would disproportionally advantage or disadvantage any particular sector.

#### *7.1.3.7. Cumulative Impacts over Time*

If the Federal surfclam harvest were to be reduced by 43.1% and remain at that level for a number of years, it would represent an enormous revenue loss for the industry as a whole. Likely impacts include the failure of businesses with tighter profit margins. Efforts to finalize the PSP testing protocol for Georges Bank would likely accelerate, in order to permit vessels to harvest surfclams and ocean quahogs from this area that is currently closed.

#### *7.1.3.8. Risk of Biological Overexploitation*

Given that the Federal surfclam resource is thought to be healthy at the current harvest level, the risk of biological overexploitation after a 43.1% reduction should be extremely low.

## 7.1.4. Alternative S2 - Slight Decrease in Surfclam Quota - 3.135 million bushels

### *7.1.4.1. Landings*

This alternative would return to the quota level that was in effect in 2002, and corresponds to a 3.5% reduction in landings relative to the status quo.

### *7.1.4.2. Exvessel Prices*

A 3.5% decrease in landings from Federal waters would have a minor impact on the market, leading to an small increase in exvessel price relative to the status quo.

### *7.1.4.3. Consumer Prices*

It is likely that a portion of the increase in exvessel prices will be passed along to consumers.

### *7.1.4.4. Consumer Surplus*

The consumer price increases that would result from adoption of this alternative would lead to a decrease in consumer surplus.

### *7.1.4.5. Producer Surplus*

The benefits to the harvesting sector of higher exvessel prices would be offset by the 3.5% decrease in Federal surfclam harvests that could be sold. In this analysis, it is assumed that the price increase would not fully compensate for the lost harvest opportunity, and result in a reduction in producer surplus.

### *7.1.4.6. Distributive Impacts*

Given that a quota reduction would impact all allocation holders proportionally, it is not considered that this alternative would disproportionally advantage or disadvantage any particular sector.

### *7.1.4.7. Cumulative Impacts over Time*

If the Federal surfclam harvest were to be reduced by 3.5% and remain at that level for a number of years, it would likely represent a moderate revenue loss for the industry. Likely impacts include increased harvests of alternative sources of meat, such as ocean quahogs.

#### 7.1.4.8. *Risk of Biological Overexploitation*

A 3.5% reduction in landings would likely ease pressure slightly on the heavily exploited areas off the coast of New Jersey. Landings per Unit of Effort (LPUE) for the Federal surfclam fleet as a whole declined 8.7% in 2002, and followed on the heels of a 10.9% decline in 2001. The most recent scientific advice available suggests that the quota can be safely increased, though a substantial increase should be avoided. Adoption of this alternative would represent a decrease in the risk of biological overexploitation relative to the status quo.

### 7.1.5. Status Quo Alternative S3 - Surfclam Quota - 3.250 million bushels

The 2003 Federal surfclam quota of 3.250 million bushels is the status quo alternative, and represents the baseline against which all other alternatives will be measured.

### 7.1.6. Alternative S4 - Slight Increase in Surfclam Quota - 3.325 million bushels

#### 7.1.6.1. *Landings*

Increasing the Federal surfclam quota to 3.325 million bushels would correspond to a 2.3% increase in landings from the status quo, or 75,000 bushels. It represents a relatively minor change from the status quo, and was chosen as an alternative because it is the mid-point between the current 3.250 million bushel quota, and the maximum allowable quota of 3.400 million bushels.

#### 7.1.6.2. *Exvessel Prices*

A 2.3% increase in quota would have a very small impact on the market, and likely lead to a very slight decrease in exvessel prices. The analysis in Amendment 13 estimates a decrease in price of $0.03 per bushel (MAFMC 2002c Table 58).

#### 7.1.6.3. *Consumer Prices*

It is possible that some of the decrease in exvessel price would be passed along to consumers, thought it is likely that it would be too small to be discernable. Those products that contain a high proportion of surfclam meat, such as the new fried clam "super-strips," would probably decrease the most.

#### 7.1.6.4. *Consumer Surplus*

The consumer price decreases that would result from adoption of this alternative would lead to an increase in consumer surplus. The analysis in Amendment 13 estimates an increase of $7,741 following an increase in quota from 3.250 million bushels to 3.325 million (MAFMC 2002c Table 58).

#### *7.1.6.5. Producer Surplus*

The analysis in Amendment 13 estimates that the lion's share of the benefits from a quota increase to 3.325 million bushels would be retained by producers, resulting in an increase in producer surplus of $375,903 (MAFMC 2002c Table 58).

#### *7.1.6.6. Distributive Impacts*

Given that a quota increase would impact all allocation holders proportionally, and that all of the increase could be sold, it is not considered that this alternative would disproportionally advantage or disadvantage any particular sector.

#### *7.1.6.7. Cumulative Impacts Over Time*

An increase in the Federal quota of only 75,000 bushels is considered too small to have any significant cumulative impacts over time.

#### *7.1.6.8. Risk of Biological Overexploitation*

The risk of biological overexploitation from a 2.3% increase in the surfclam quota is thought to be very small, though it must be considered slightly higher than the status quo.

7.1.7. Summary of Surfclam Impacts

| **Summary of Impacts for Proposed 2004 Surfclam Quota Alternatives Relative to Status Quo Alt. S3: 3.250 million bushels** | | | | |
|---|---|---|---|---|
| Feature | Alt. S1<br>Min. Allowable<br><br>1.850 million bushels | Alt. S2<br>Slight Decrease<br><br>3.135 million bushels | Alt. S4<br>Slight Increase<br><br>3.325 million bushels | Alt. S5 (Preferred)<br>Max. Allowable<br><br>3.400 million bushels |
| Landings | - 43.1% | - 3.5% | + 2.3% | + 4.6% |
| Exvessel Prices | Significant + | + | Very Slight - | Slight - |
| Consumer Prices | Significant + | + | Very Slight - | Slight - |
| Consumer Surplus | Significant - | - | Very Slight + | Slight + |
| Harvest Costs | 0 | 0 | 0 | 0 |
| Producer Surplus | Significant - | - | Very Slight + | Slight + |
| Enforcement Costs | 0 | 0 | 0 | 0 |
| Distributive Impacts | 0 | 0 | 0 | 0 |
| Cumulative Impacts | + | Slight + | 0 | (?) |
| Risk of Biological Overexploitation | Significant - | - | Very Slight + | Slight + |
| + indicates an increase relative to the status quo; - indicates a decrease relative to the status quo; 0 indicates no change; ? indicates unknown | | | | |

*7.1.7.1. Summary Justification for Surfclam 3.400 Million Bushel Quota Recommendation*

The Council staff has identified five alternative quotas for the Council to consider for the year 2004. Since the 2003 quota of 3.25 million bushels is already relatively close to the maximum allowable of 3.40 million, the two alternatives which would increase the quota correspond to percentage increases of only 2.3% and 4.6%. The staff is recommending an increase of the full 4.6% to 3.4 millions bushels for the reasons discussed below.

The picture we have of the surfclam resource and fishery is complex, and has elements that can and do change from year to year. Yet the bottom line is that the best scientific advice we currently have indicates that an increase in the annual quota to the maximum OY level of 3.4 million bushels is sustainable. Our most recent biological assessments (both in 1998 and 2000) indicated that the resource is healthy, composed of many age classes, and can safely sustain increased harvests. At the time of this writing, a new assessment is in the final stages of completion, with a draft Advisory Report now in distribution. It concludes that the surfclam stock in the EEZ is not overfished, and overfishing is not occurring.

However, there are a number of factors that argue for a cautious approach in the management of this resource in the years ahead. The most important of these is the substantial decline in surfclam biomass estimated to have occurred between the 1999 and 2002 surveys. Contributing to this is evidence of increased mortality in the inshore, southern regions of the survey, perhaps due to elevated sea temperature. Secondly, Landings per Unit of Effort (LPUE) for the Federal surfclam fleet as a whole declined 10.9% in 2001, and then an additional 8.7% in 2002. Third, the draft advisory report for the latest assessment noted that survey recruitment indices were low in both 1999 and 2002. Finally, there are significant uncertainties that remain in the biological assessments. Additional data, time, and refinement of methods will be required to reduce that uncertainty in the future.

On a more encouraging note, the underutilization of the New York inshore surfclam quota has ended, and there have been at least anecdotal reports of new surfclam recruits in a number of areas, particularly off New York, and in deeper waters.

## 7.2. Analysis of Ocean Quahog Alternatives

There are five alternative quota levels considered for the 2004 ocean quahog fishery:

| **2004 Ocean Quahog Quota Alternatives** | | | |
|---|---|---|---|
| Alt. Q1 | Min. Allowable | 4.000 million | 11.1% Decrease |
| Alt. Q2 | Partial Reduction | 4.250 million | 5.6% Decrease |
| Alt. Q3 | Status Quo | 4.500 million | No Change |
| Alt. Q4** | Increase | 5.000 million | 11.1% Increase |
| Alt. Q5 | Max. Allowable | 6.000 million | 33.3% Increase |
| ** Council Recommendation | | | |

At the June 2003 Council meeting in Philadelphia, Pennsylvania, the Mid-Atlantic Council voted to recommend that the 2004 ocean quahog ITQ quota outside Maine be increased by 11.2% to 5.000 million bushels.

### 7.2.1. Summary Evaluation of All Quahog Quota Alternatives - Assumes NONE of the Quota Alternatives Would be Binding on the Industry

Historically, the ocean quahog fishery outside of Maine has played a supplementary role to the surfclam fishery. The ocean quahog fishery was first initiated in 1976 by surfclam vessels in response to a major decline in the availability of surfclams. With a smaller meat and sharper flavor than surfclams, it commanded less than half the price in the marketplace. Ocean quahog beds were also located further offshore than surfclams, such that the added fuel costs were an additional damper on the profitability of ocean quahog trips. Processors could still make a profit on ocean quahogs, and would often cajole captains and crews into making more quahog trips by assuring them they would purchase all their surfclam harvests at an acceptable price.

The advantage that ocean quahogs have had are the massive, dense beds that have developed across decades or even centuries of time. Vessels have been able to harvest the long-lived animals in large quantities, very quickly. The resource off the Atlantic coast has supported intense harvests for over two and one-half decades, and scientists believe that even when the closed portions of the resource are excluded, 82% of the virgin biomass remains untouched.

For this reason, the annual quotas for ocean quahogs have generally been set substantially higher than the levels industry has chosen to harvest. From 1998 through 2002, harvests have not even reached the minimum quota level of 4.0 million bushels. The optimum yield range currently specified in the surfclam and ocean quahog FMP is between 4.0 and 6.0 million bushels. Hence the quota alternatives which the Council may recommend to the Secretary of Commerce must all fall within that allowable range. **When industry harvests do not even reach the relevant quota range, none of the alternatives would be binding on the industry, and hence none of the alternatives are expected to have any impact on the following areas:**

- Landings
- Exvessel prices
- Consumer prices
- Consumer surplus
- Harvest costs
- Producer surplus
- Enforcement costs
- Risk of biological overexploitation

### *7.2.1.1. Distributive and Cumulative Impacts*

Given the situation in which ocean quahog harvest levels to not reach any of the quota alternative levels, the only areas of potential impact are distributive and cumulative in nature. Quota shares in the ITQ fisheries for surfclams and ocean quahogs are held by large corporations as well as small, independent fishermen. One concern that has been raised is that when large amounts of quota are not utilized by industry, the revenue losses from unsold quota may fall disproportionally on independent fishermen with lesser access to a market. If these losses fall repeatedly on the same individuals over a period of years, they may be forced to cease operations, or sell their quota allocations at a loss. The relative size of any such impacts would be expected to be proportional to the amount of surplus quota created by the government: greater impacts from larger surpluses, and lesser impacts from smaller surpluses.

A summary of all impacts that can be expected from a repetition of the historical ocean quahog landing pattern in 2004, in which quotas are not binding on the industry, is represented in the following table.

| **Summary of Impacts for Proposed 2004 Ocean Quahog Quota Alternatives Relative to Status Quo Alt Q3: 4.500 million bushels - Assumes NONE of the Quota Alternatives are Binding on the Industry** | | | | |
|---|---|---|---|---|
| Feature | Alt. Q1<br>Min. Allowable<br><br>4.000 million bushels | Alt. Q2<br>Slight Decrease<br><br>4.250 million bushels | Alt. Q4<br>Increase<br><br>5.000 million bushels | Alt. Q5<br>Max. Allowable<br><br>6.000 million bushels |
| Landings | - 11.1% allowed<br>(less than 4 mill. expected) | - 5.6% allowed<br>(less than 4 mill. expected) | + 11.1% allowed<br>(less than 4 mill. expected) | + 33.3% allowed<br>(less than 4 mill. expected) |
| Exvessel Prices | 0 | 0 | 0 | 0 |
| Consumer Prices | 0 | 0 | 0 | 0 |
| Consumer Surplus | 0 | 0 | 0 | 0 |
| Harvest Costs | 0 | 0 | 0 | 0 |
| Producer Surplus | 0 | 0 | 0 | 0 |
| Enforcement Costs | 0 | 0 | 0 | 0 |
| Distributive Impacts | - | - | + | + |
| Cumulative Impacts | - | - | + | + |
| Risk of Biological Overexploitation | 0 | 0 | 0 | 0 |
| + indicates an increase relative to the status quo; - indicates a decrease relative to the status quo; 0 indicates no change; ? indicates unknown | | | | |

## 7.2.2. Summary Evaluation of All Quahog Quota Alternatives - Assumes Quotas are Binding on the Industry

It should be noted that the potential exists for at least some of the 2004 ocean quahog quota alternatives to be limiting on the industry. The surge in demand for clam meats in 2001 could not be met with surfclams alone, and obliged the processing sector to raise the price of ocean quahogs dramatically. A steady decline in the productivity of dense ocean quahog beds was not being offset with a compensating increase in exvessel price. Median price had remained steady at $4.25 per bushel for years, and an increasing number of vessels were refusing to fish for them.

In 2001, processors relented and a majority of ocean quahog landings were purchased at prices ranging between $5.00 and $6.10 per bushel. This spurred a 17% increase in ocean quahog landings to 3.691 million bushels in 2001. In 2002 landings edged higher to 3.871 million bushels. Current landing trends in 2003 indicate that total landings for the year may exceed the 4.0 million bushel level, though not reach the 4.5 million bushel level so as to be limited by the 2003 quota. Hopes for major increases in quahog landings were dealt a blow when the 'Four Daughters' sank in July of 2003, a large new vessel primarily involved in the ocean quahog fishery.

Whether these unusually strong harvest rates will be maintained through 2004 and beyond is uncertain: the dramatic increase in price which spurred them is unprecedented in the recent history of these fisheries. It is likely, however, that the declining availability of surfclams in New Jersey state waters combined with the overall decline in surfclam biomass will serve to increase fishing pressure on the ocean quahog resource.

With these factors in mind, the Council voted to increase the ocean quahog ITQ quota by 11.1% from 4.5 million bushels to 5.0 million bushels in 2004. Again, it is unlikely that the industry will be able to utilize 5 million bushels as soon as 2004, however, under the assumption that it might be binding on the industry, the impacts of the proposed quota alternatives for 2004 can be summarized in the following table.

| **Summary of Impacts for Proposed 2004 Ocean Quahog Quota Alternatives Relative to Status Quo Alt Q3: 4.500 million bushels - Assumes Quotas Binding on Industry** | | | | |
|---|---|---|---|---|
| Feature | Alt. Q1<br>Min. Allowable<br><br>4.000 million bushels | Alt. Q2<br>Slight Decrease<br><br>4.250 million bushels | Alt. Q4<br>Increase<br><br>5.000 million bushels | Alt. Q5<br>Max. Allowable<br><br>6.000 million bushels |
| Landings | - 11.1% | - 5.6% | + 11.1% | + 33.3% |
| Exvessel Prices | + | Slight + | Small - | - |
| Consumer Prices | + | Slight + | Small - | - |
| Consumer Surplus | - | Slight - | Small + | + |
| Harvest Costs | 0 | 0 | 0 | 0 |
| Producer Surplus | - | Slight - | Small + | + |
| Enforcement Costs | 0 | 0 | 0 | 0 |
| Distributive Impacts | 0 | 0 | 0 | 0 |
| Cumulative Impacts | 0 | 0 | 0 | ? |
| Risk of Biological Overexploitation | - | Slight - | Small + | + |
| + indicates an increase relative to the status quo; - indicates a decrease relative to the status quo; 0 indicates no change; ? indicates unknown | | | | |

### 7.2.3. Maine Ocean Quahog Fishery Quota

| **Alternative 2004 Quotas for the Maine Quahog Fishery** | | | |
|---|---|---|---|
| Alt. M1 | 50% of Max. Quota | 50,000 Maine Bu. | 50% Decrease |
| Alt. M2 | Status Quo less 2002 Quota Overage | 84,700 Maine Bu. | 18% Decrease |
| Alt. M3** | Max Allowable - Status Quo | 100,000 Maine Bu. | No Change |
| ** Council Recommendation | | | |

7.2.3.1. Preferred Alternative M3 - Max Allowable - 100,000 Maine Bu. (Status Quo)

The Council voted to recommend that the Maine ocean quahog quota remain unchanged for 2004 at the initial maximum quota level of 100,000 bushels. This quota pertains to the zone of both state and Federal waters off the eastern coast of Maine north of 43 degrees 50 minutes north latitude. Amendment 10 established management measures for this small artisanal fishery in May of 1998, and specified an initial maximum quota of 100,000 bushels. This same level has been maintained each year through 2003. Representatives of Maine encouraged the Council to maintain that quota for 2004 as well.

The issue of greatest concern to the Mid-Atlantic Council has been the substantial quota overages that occurred in 2000 and 2002 due to late reporting. For example, in 2002, total landings for the year reached just over 128,500 bushels. This was comprised of the 100,000 bushel quota for the Maine harvest zone, 13,200 bushels purchased from the ITQ fishery, and a 15,300 bushel quota overage. The overage occurred because the fishery was not closed early enough to halt landings at the 100,000 bushel mark, given the lag time which occurs between the time harvests actually take place, and the time landing reports are submitted to NMFS and keyed into the landings database.

Preliminary landing statistics as of July 31, 2003 indicated that 60% of the Maine ocean quahog quota had been harvested, while approximately 58% of the year had passed by. Landings tend to taper off after the Labor Day holiday weekend, however late reporting makes it likely that the 100,000 bushel quota will be reached again in 2003. If fishermen wish to continue harvesting after this quota is reached, they must again purchase allocation from the ITQ portion of the ocean quahog fishery. One impact of this "maximum allowable" quota alternative is that it would minimize the costs of ITQ purchases from the other sector of the fishery.

Specification of a sustainable harvest limit for the Maine fishery remains problematic for two principal reasons. First and foremost, because a survey and assessment of the resource off Maine is not yet complete. The State of Maine started field work on an ocean quahog survey in the spring of 2002. It was planned that survey work would continue in 2003, followed by a stock assessment that would be peer reviewed through the SARC/SAW process in December 2003. A shortage of funding caused work to be halted temporarily in 2003, and the Council is awaiting further news as to when work will be resumed.

The second issue involves public safety closures for PSP toxin. Due to the health risks associated with toxins that may appear in a number of shellfish species on this portion of the coast, Maine officials only allow fishing to occur in those areas that are being actively monitored. Other areas may contain ocean quahogs, but remain unavailable to fishermen due to the lack of sampling coverage. This raises the question as to whether a sustainable harvest limit should pertain to only those areas that are typically open to fishing, or to the entire Maine ocean quahog fishery zone above $43^{o}$ 50'.

In any regard, this alternative would maintain the status quo quota of 100,000 Maine bushels for another year, and represents the baseline against which all other quota alternatives will be measured. An examination of the available fishery performance data for the Maine fishery indicate that Landings Per Unit of Effort have ranged from a low of 1.8 bushels per hour in 1992, to a peak of 9.5 bushels per hour in 2000. The 7.6 bushel per hour average in 2002 remains at the upper end of the range, suggesting that the Maine resource availability continues to be above average.

Given the stability that has been apparent in the Maine fishery in recent years, the Mid-Atlantic Council does not feel there is justification for reducing the Maine quota below the current 100,000 bushel maximum for 2004. Survey and assessment information from the Maine research should be available in the near future, and will provide a more solid basis for increases or decreases in the quota in subsequent years.

### 7.2.3.2. Alternative M1 - 50% of Maximum Quota - 50,000 Maine Bu.

#### *7.2.3.2.1. Landings*

Reducing the Maine ocean quahog quota to 50% of the maximum allowable under the existing management plan represents a 50% reduction in potential landings versus the status quo. However, it is assumed that once the "free" quota assigned to the Maine fishery is harvested, Maine fishermen would rent ocean quahog quota from the ITQ fishery to replace it.

For the purposes of this analysis, it is assumed that the rental price will be $1.00 per bushel in mid-2004. It is further assumed that if the 2004 Maine quota were reduced by 50,000 bushels, that 90% of the reduction would be replaced by rented allocation from the ITQ fishery.

#### *7.2.3.2.2. Exvessel Prices*

A reduction in the "free" quota available to Maine quahog fishermen will oblige them to replace it with rented quota from the ITQ fishery. Rented quota, therefore, will simply become an additional variable cost of harvest operations.

Without knowledge of the elasticities of demand and supply in the fresh, half-shell market, it is difficult to predict changes in exvessel prices. However, a 50% reduction in the Maine quota would be a significant event for the Maine fishery, given that more than the 100,000 bushel quota is now being utilized. The Maine quota would likely be exhausted in mid-year, when most of the Maine vessels are still participating in the fishery. Most of the vessels, therefore, would be obliged to rent quota from the ITQ fishery. The additional $1.00 per bushel cost would be minimal considering the much higher value which Maine quahogs command when compared to landings from the ITQ fishery. The average exvessel price for Maine ocean quahogs was $36.89 per Maine bushel in 2002, compared with $5.36 per bushel in the ITQ fishery.

It is expected that Maine fishermen would be able to pass along a portion of their increased costs from renting quota, resulting in a slightly higher exvessel price for Maine ocean quahogs.

#### *7.2.3.2.3. Consumer Prices*

With exvessel prices expected to increase slightly under this alternative, prices to consumers may increase very slightly.

#### *7.2.3.2.4. Consumer Surplus*

Assuming that consumers would pay a slightly higher retail price for Maine ocean quahogs, consumer surplus would decrease slightly.

#### *7.2.3.2.5. Harvest Costs*

After the free Maine ocean quahog quota is exhausted, fishermen are expected to rent quota from the ITQ fishery. The cost per ITQ bushel is estimated at $1.00. Assuming that the 90% of the quota reduction of 50,000 bushels is replaced, the increased harvesting costs would equal $45,000 across all vessels.

#### *7.2.3.2.6. Producer Surplus*

It is expected that producers (vessels) will be obliged to absorb a portion of the increased costs of harvest that would result from renting ITQ quota. Producer surplus would correspondingly decrease slightly.

#### *7.2.3.2.7. Enforcement Costs*

With the widespread use of ITQ quota in Maine that this alternative envisions, the costs of tracking and enforcing it would increase.

#### *7.2.3.2.8. Distributive Impacts*

No significant distributive impacts are foreseen from adoption of this alternative.

#### *7.2.3.2.9. Cumulative Impacts*

No significant cumulative impacts are foreseen from adoption of this alternative.

*7.2.3.2.10. Risk of Biological Overexploitation*

The risk of localized overexploitation exists in all of the management alternatives currently available for the Maine ocean quahog fishery. From a coast-wide perspective, there is little risk to the ocean quahog resource from the total allowable harvest of the combined ITQ and Maine ocean quahog quotas.

This alternative estimates that landings would drop by 5,000 Maine bushels in response to the additional expense of renting 45,000 from the ocean quahog ITQ fishery. Hence, the risk of biological overexploitation would be slightly lower than under the status quo, preferred alternative.

***Communications with the Maine Department of Marine Resources indicate that work on an assessment of the ocean quahog resource in the Gulf of Maine commenced in the spring of 2002 (Mercer, pers. comm). A $23,000 grant from the Northeast Consortium was received to fund initial efforts, which took the form of cooperative research using the Maine industry vessel "Whitney and Ashley." While currently there is no funding committed to recurring sampling across time, the Department is optimistic that both State and industry support for the program will increase and allow research efforts to continue.***

7.2.3.3. Alternative M2 - Status Quo less 2002 Overage - 84,700 Maine Bu.

*7.2.3.3.1. Landings*

Reducing the Maine quahog quota by the 15,300 Maine bushel overage in 2002 represents an 18% reduction in potential landings versus the status quo. However, it is again assumed that once the "free" quota assigned to the Maine fishery is harvested, fishermen would simply rent ocean quahog quota from the ITQ fishery to replace it. For the purposes of this analysis, it is assumed that 90% of the reduction would be replaced through rentals, or 13,770 bushels. Total landings would then equal 98,470 Maine bushels.

*7.2.3.3.2. Exvessel Prices*

Given the landings pattern exhibited in 2002, a quota of 84,700 Maine bushels should sustain the fishery through the peak summer months. This would limit the additional costs of renting ITQ to only those vessels active in the final few months of the year. As with the prior alternative, it is expected that vessels will be able to recoup a portion of the added costs through slightly higher exvessel prices.

*7.2.3.3.3. Consumer Prices*

The magnitude of the increase in exvessel prices under this alternative is considered to be so small that is it unlikely to have a discernable impact on consumer prices.

*7.2.3.3.4. Consumer Surplus*

With consumer prices expected to remain constant under this alternative, no changes in consumer surplus would result.

*7.2.3.3.5. Harvest Costs*

It is expected that vessels would respond to an 18% decrease in the Maine quota by renting back 90% of the loss from the ITQ portion of the fishery. This would entail a purchase of 13,770 bushels. At an estimated cost of $1.00 per bushel, this would result in an increase of $13,770 in harvest costs across all vessels.

*7.2.3.3.6. Producer Surplus*

It is expected that producers (vessels) will be obliged to absorb a portion of the increased costs of harvest that would result from renting ITQ quota. Producer surplus would correspondingly decrease slightly.

*7.2.3.3.7. Enforcement Costs*

With the need to administer and track the use of ITQ quota in the Maine fishery, enforcement costs would increase. However, with utilization limited to only those vessels remaining active in the final months of the year, the costs would be less than those resulting from the prior (50% of Maximum Quota) alternative.

*7.2.3.3.8. Distributive Impacts*

No significant distributive impacts are foreseen from adoption of this alternative.

*7.2.3.3.9. Cumulative Impacts*

No significant cumulative impacts are foreseen from adoption of this alternative.

*7.2.3.3.10. Risk of Biological Overexploitation*

This analysis assumes that landings would decline by 1,530 Maine bushels due to the added costs of renting ITQ allocation. Hence, there would be a very slight decrease in the risk of biological overexploitation of the Maine ocean quahog resource relative to the status quo alternative.

7.2.3.4. Summary of Maine Ocean Quahog Quota Impacts

| **Summary of Impacts for Proposed 2004 Maine Ocean Quahog Quota Alternatives Relative to Status Quo Alt M3: 100,000 Maine bushels (Preferred)** | | |
|---|---|---|
| Feature | Alt. M1<br>50% of Maximum Quota<br><br>50,000 Maine bushels | Alt. M2<br>Status Quo less 2002 Quota Overage<br><br>84,700 Maine bushels |
| Landings | -5,000 (assumes 45,000 Maine bushels will be leased from ITQ portion of the fishery) | -1,530 (assumes that 13,770 Maine bushels will be leased from ITQ portion of the fishery) |
| Exvessel Prices | Slight + | Very Slight + |
| Consumer Prices | Slight + | 0 |
| Consumer Surplus | Slight - | 0 |
| Harvest Costs | + $45,000 | + $13,770 |
| Producer Surplus | Slight - | Slight - |
| Enforcement Costs | + | + |
| Distributive Impacts | 0 | 0 |
| Cumulative Impacts | 0 | 0 |
| Risk of Biological Overexploitation | Slight - | Very Slight - |
| + indicates an increase relative to the status quo; - indicates a decrease relative to the status quo; 0 indicates no change; ? indicates unknown | | |

**7.3. Other Management Actions: Suspend Minimum Size Restriction on Surfclams for 2004**

The Surfclam and Ocean Quahog FMP includes a provision for a minimum size limit of 4.75 inches on surfclams, which may be used to protect new year classes from harvest before they have reached an optimal size. The provision is written such that a minimum size will automatically be in effect unless the Council takes the active step of suspending it each year.

The current stock is comprised primarily of large, adult individuals, with few small individuals apparent from landings in most areas. Reinstating a minimum size under these conditions would result in greater harm than benefit, as it would require the industry to use "sorting" machines which will often damage undersized clams as it routes them back overboard.

It is, therefore, the Council's recommendation that the surfclam minimum size limit be suspended for 2004, as has been done since 1990. Continuing the suspension will have no impact on the current fishery.

7.3.1. The Alternative of Allowing the Surfclam Minimum Size Limit to take Effect in 2004

Each year the Council must take the active step of suspension, or a minimum size of 4.75 inches will automatically go into effect as of January 1. The current regulations read as follows:

> § 648.72 Minimum surf clam size.
>
> (a) Minimum length. The minimum length for surf clams is 4.75 inches (12.065 cm).
>
> (b) Determination of compliance. No more than 50 surf clams in any cage may be less than 4.75 inches (12.065 cm) in length. If more than 50 surf clams in any inspected cage of surf clams are less than 4.75 inches (12.065 cm) in length, all cages landed by the same vessel from the same trip are deemed to be in violation of the minimum size restriction.
>
> ©) Suspension. Upon the recommendation of the MAFMC, the Regional Administrator may suspend annually, by publication in the Federal Register, the minimum shell-height standard, unless discard, catch, and survey data indicate that 30 percent of the surf clams are smaller than 4.75 inches (12.065 cm) and the overall reduced shell height is not attributable to beds where the growth of individual surf clams has been reduced because of density dependent factors.
>
> (d) Measurement. Length is measured at the longest dimension of the surf clam shell.

The minimum size provision for the surfclam fishery is a measure that is most appropriate when a large proportion of the resource is comprised of smaller, younger surfclams. Its application can help ensure the continued viability of a young, or recovering resource by delaying their harvest until they have had multiple opportunities to spawn. It is also intended to improve the overall meat yield from a fishery by postponing harvest until after the rapid growth phase which occurs in the adolescence of most species.

The condition of having a large portion of the resource in an immature state occurred in the surfclam fishery following the anoxia event in the summer of 1976. Low levels of dissolved oxygen in the water off the coast of New Jersey killed large portions of the surfclam resource available at the time. In the subsequent years the Mid-Atlantic Council implemented a series of management measures for surfclams. These included quarterly harvest quotas, a moratorium on new vessels entering the fishery, effort limitations, reporting requirements, closed areas, and an initial minimum size limit of 5.5 inches.

Unfortunately, in addition to the desired effect, each of these measures also produced some negative side effects. Quarterly quotas that were shared among all vessels still motivated a race to fish as vessels sought to harvest as much as possible before the quota was reached and the fishery closed. The vessel moratorium made the replacement of ageing vessels difficult and contentious. Effort limitations which limited the amount of time a vessel could operate were expensive to enforce and costly to vessel owners in the forced down-time of their vessels. Closed nursery areas were very expensive to enforce because they required the use of Coast Guard cutters or surveillance aircraft, and it is considered likely that the stunting of the surfclam resource off Chincoteague, Virginia was contributed to by the area closure.

Minimum size limits are also subject to their share of unintended consequences. The minimum size for surfclams was generally favored by processors because it obliged fishermen to bring them the most profitable, high-yielding clams. However, vessel owners were subject to fines if their catches were found to be in violation, and resource benefits are muted when captains are unable to avoid small individuals, and are forced to discard them.

The culling out of small clams is most often accomplished with sorting machines, which will direct clams across a series of parallel metal rollers, allowing the smaller individuals to fall between the rollers and be shunted back overboard. Fracture of the clam shell during this process is common, and a significant portion of the animals returned to the ocean will not survive.

In the 2002 surfclam logbook data, the average reported discard rate was 2.8%. In the June 2003 SARC, the total non-landed mortality was estimated at 12%. Numbers of this magnitude are not suggestive of a population dominated by small individuals. Moreover, assessment figures continue to indicate that the stock is comprised primarily of large, adult individuals. Reinstating a minimum size under these conditions would result in greater harm than benefit, because it would result in higher discard mortality through the expanded use of sorters, as vessel owners seek to minimize the risk of fines.

It is, therefore, the Council's recommendation that the surfclam minimum size limit be suspended for 2004, as has been done since 1990. Continuing the suspension will provide substantial benefits through maintaining a low discard mortality rate, while giving up little in the way of increased survival of juveniles.

# 8.0. INITIAL REGULATORY FLEXIBILITY ANALYSIS - IMPACTS ON SMALL ENTITIES

## 8.1. 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 Individual Transferrable Quota (ITQ) holders and fishermen in the commercial Atlantic surfclam and ocean quahog fishery. The impacts of the proposed action on the fishing industry and the economy 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.

The Small Business Administration (SBA) defines a small business in the commercial fishing sector as a firm with receipts (gross revenues) of up to $3.0 million. The Northeast Regional Office of the National Marine Fisheries Service maintains current ownership records of surfclam and ocean quahog allocation holders. Tables 1 and 2 contain listings of surfclam and ocean quahog allocation holders respectively as of June 30, 2003. These are the entities that will be most directly impacted by the setting of annual quotas.

Table 1. Surfclam Allocation Owners as of June 30, 2003

| No. of Allocation Holders | State | Total Bushels Held | Bu/Holder |
|---|---|---|---|
| 65 | NJ | 1,470,272 | 22,620 |
| 16 | VA | 986,272 | 61,642 |
| 10 | MD | 265,216 | 26,522 |
| 11 | VAR* | 485,888 | 44,172 |
| | | | |
| **Total = 102** | | **3,207,648** | **31,448** |

* Var = CT, FL, MA, NY, RI

Table 2. Ocean Quahog Allocation Owners as of June 30, 2003

| No. of Allocation Holders | State | Total Bushels Held | Bu/Holder |
|---|---|---|---|
| 42 | NJ | 2,112,976 | 50,547 |
| 7 | MD | 275,232 | 39,319 |
| 7 | VA | 913,504 | 130,501 |
| 7 | VAR* | 1,181,856 | 168,837 |
| **Total = 63** | | **4,493,568** | **71,326** |

*Var = FL, GA, ME, NY, RI

Table 3 lists the number of vessels active in harvesting surfclams and ocean quahogs in the non-Maine fisheries. Some of these vessels may not hold allocations. Depending on the regulations promulgated, the population affected by the regulation may change, i.e. if, for example, an area is closed, both holders and service providing vessels may be affected, while with a quota change, only holders may appropriately be affected and service providers impacted.

| Table 3. Vessel Participation in the 2002 Surfclam and non-Maine Ocean Quahog Fisheries | |
|---|---|
| **Species Harvested** | **Number of Vessels** |
| Surfclams only | 23 |
| Ocean Quahogs only | 15 |
| BOTH Surfclams and Ocean Quahogs | 16 |
| | |
| **TOTAL** | **54** |

Average 2002 gross income for surfclam vessels was $740,500 per vessel, and for ocean quahog ITQ vessels was $668,990. In the small artisanal fishery for ocean quahogs in Maine, 35 vessels reported harvests in the clam logbooks, with an average value of $135,511 per boat. All of these vessels readily fall within the definition of small businesses.

## 8.2. Analysis of the Impacts of Alternatives

### 8.2.1. Impacts on the Recreational Sector of All Alternatives

Atlantic surfclams and ocean quahogs are harvested exclusively by the commercial entities. None of the proposed alternatives will have any impact on the recreational sector.

### 8.2.2. Impacts of the Surfclam Quota Alternatives

The impacts of adjustments to the Federal quota for surfclams on small businesses is exceptionally straightforward to assess. Both the surfclam and ocean quahog fisheries are single-species fisheries, with almost no bycatch of other commercially-valuable or protected species. Vessels are able to effectively target each species individually, without the risk of needing permits for other species, or running afoul of closed seasons or minimum sizes. The 2004 specifications establish a 4.6-percent increase in the surfclam quota, an 11.1% increase in the ocean quahog ITQ quota, and does not change the Maine ocean quahog quota. Since 2002 harvest levels of 3.113 and 3.871 million bu for surfclams and ocean quahogs, respectively, were below the 2004 quotas implemented by this action, NMFS and the Council believe that the 2004 quotas may yield a surplus quota available to vessels participating in all these fisheries. This is especially likely to occur in the ocean quahog fishery. In the case of a surplus quota, vessels would not be constrained from harvesting additional product, thus allowing them to increase their revenues.

Direct impacts of quota adjustments will be felt by the 102 entities currently holding surfclam ITQ allocations. The actual number of individuals or businesses holding the 102 registered allocations will be smaller, since each holder will often maintain multiple allocations for accounting, or liability purposes.

*8.2.2.1 Preferred Alternative S5 - 4.6% Increase in Surfclam Quota - 3.400 million bushels*

The average surfclam quota allocation currently equals 31,448 bushels. A 4.6% increase would add 1,447 bushels to each. At an average exvessel value of $12.00 per bushel, the gross value of the quota increase would equal $17,364 per allocation.

There are no other significant impacts of the proposed action on small entities. Reporting costs and compliance costs would not change as a result of the proposed action.

*8.2.2.2 NON-PREFERRED Alternative S1 - 43.1% Decrease in Surfclam Quota - 1.850 million bushels*

A 43.1% decrease in the Federal surfclam quota would subtract 13,554 bushels from the current average allocation of 31,448 bushels. At an average exvessel value of $12.00 per bushel, the gross value of the quota decrease would equal $162,648 per allocation.

Such a large reduction in the quota would have a major impact on small entities, and is not recommended by the Council.

*8.2.2.3 NON-PREFERRED Alternative S2 - 3.5% Decrease in Surfclam Quota - 3.135 million bushels*

A 3.5% decrease in the Federal surfclam quota would subtract 1,101 bushels from the current average allocation of 31,448 bushels. At an average exvessel value of $12.00 per bushel, the gross value of the quota decrease would equal $13,208 per allocation.

Given the current biological status of the stock, the Council does not believe a quota reduction is warranted at this time, and hence this alternative is not recommended for adoption in 2004.

*8.2.2.4 NON-PREFERRED Alternative S3 - Status Quo Surfclam Quota - 3.250 million bushels*

Maintaining the current surfclam quota of 3.135 million bushels would result in no change from the status quo.

*8.2.2.5 NON-PREFERRED Alternative S4 - 2.3% Increase in Surfclam Quota - 3.325 million bushels*

A 2.3% increase in the Federal surfclam quota would add 723 bushels to the current average allocation of 31,448 bushels. At an average exvessel value of $12.00 per bushel, the gross value of the quota increase would equal $8,680 per allocation.

The Mid-Atlantic Council is recommending a larger quota increase of 4.6% because it is believed to be sustainable, and would provide greater benefits.

### 8.2.3. Impacts of the Ocean Quahog ITQ Quota Alternatives

Direct impacts of quota adjustments will be felt by the 63 entities currently holding ocean quahog ITQ allocations.

#### *8.2.3.1 Preferred Alt. Q4 - 11.1% Increase in Ocean Quahog Quota - 5.000 million bushels*

An 11.1% increase in the Federal ocean quahog quota would add 7,918 bushels to the current average allocation of 71,326 bushels. At an average exvessel value of $6.00 per bushel, the gross value of the quota increase would equal $47,503 per allocation.

Note that it is unlikely that ocean quahog harvest levels will actually reach the 5.0 million bushel level in 2004. The historical trend has been that industry harvest levels have only rarely approached the ocean quahog quota.

#### *8.2.3.2 NON-PREFERRED Alt. Q1 - 11.1% Decrease in Ocean Quahog Quota - 4.000 million bushels*

An 11.1% decrease in the Federal ocean quahog quota would subtract 7,917 bushels from the current average allocation of 71,326 bushels. At an average exvessel value of $6.00 per bushel, the gross value of the quota decrease would equal $47,503 per allocation.

#### *8.2.3.3 NON-PREFERRED Alt. Q2 - 5.6% Decrease in Ocean Quahog Quota - 4.250 million bushels*

A 5.6% decrease in the Federal ocean quahog quota would subtract 3,994 bushels from the current average allocation of 71,326 bushels. At an average exvessel value of $6.00 per bushel, the gross value of the quota decrease would equal $23,966 per allocation.

#### *8.2.3.4 NON-PREFERRED Alt. Q3 - Status Quo Ocean Quahog Quota - 4.500 million bushels*

Maintaining the current ocean quahog quota of 4.500 million bushels would result in no change from the status quo. Hence, this alternative would have no impact on revenues, compliance costs, or reporting costs for small entities.

*8.2.3.5 NON-PREFERRED Alt. Q5 - 33.3% Increase in Ocean Quahog Quota - 6.000 million bushels*

A 33.3% increase in the Federal ocean quahog quota would add 23,752 bushels to the current average allocation of 71,326 bushels. At an average exvessel value of $6.00 per bushel, the gross value of the quota increase would equal $142,509 per allocation.

The Mid-Atlantic Council is not recommending a quota increase of this magnitude for the ocean quahog fishery due to a number of factors. Primary among them is uncertainty in the recent stock assessment, and substantial amounts of unutilized quota in recent years.

8.2.4. Impacts of the Maine Ocean Quahog Quota Alternatives

The Maine ocean quahog fishery is currently prosecuted by a total of 35 small vessels. The annual quota pertains to the Maine ocean quahog zone, and is not allocated to individual allocation holders as is the case outside of Maine. Once the Maine quota is harvested, fishing may only proceed if quota is rented from the ITQ fishery outside of Maine.

*8.2.4.1 Preferred Alt. M3 - Status Quo Maine Ocean Quahog Quota - 100,000 Maine bu.*

Maintaining the current Maine ocean quahog quota of 100,000 Maine bushels would result in no change from the status quo. Hence, the preferred alternative would have no impact on revenues, compliance costs, or reporting costs for small entities.

*8.2.4.2 NON-PREFERRED Alt. M1 - 50% Decrease in Maine Ocean Quahog Quota - 50,000 Maine bu.*

In 2002, a total of 35 vessels participated in the Maine ocean quahog fishery. It is assumed that if the Maine quota were reduced by 50% to 50,000 Maine bushels, 90% of the reduction would be replaced by renting allocation from the ITQ fishery. This would equal a total of 45,000 bushels rented, at an estimated $1.00 per bushel. Divided amongst the 35 vessels in the fleet, the average cost per vessel would equal $1,286.

*8.2.4.3 NON-PREFERRED Alt. M2 - 18.1% Decrease in Maine Ocean Quahog Quota - 84,700 Maine bu.*

It is assumed that if the Maine quota were reduced by 18.1% to 84,700 Maine bushels, 90% of the reduction would be replaced by renting allocation from the ITQ fishery. This would equal a total of 13,770 bushels rented, at an estimated $1.00 per bushel. Divided amongst the 35 vessels in the fleet, the average cost per vessel would equal $393.

8.2.5. Impacts of the Suspending the Surfclam Minimum Size Limit Alternatives

*8.2.5.1 Preferred Alt. - Status Quo - Maintain Surfclam Size Limit Suspension in 2004*

Maintaining the suspension of the surfclam minimum size limit would result in no change from the status quo. Hence, the preferred alternative would have no impact on revenues, compliance costs, or reporting costs for small entities.

*8.2.5.2 NON-PREFERRED Alt. Allow Surfclam Size Limit to Take Effect in 2004*

The current stock is comprised primarily of large, adult individuals, with few small individuals apparent from landings in most areas. Reinstating a minimum size under these conditions would result in greater harm than benefit, as it would require the industry to use "sorting" machines which will often damage undersized clams as it routes them back overboard.

It is expected that adopting this alternative would result in substantial costs to small business entities, without producing a significant compensating benefit to the surfclam resource. Hence, the Mid-Atlantic Council does not recommend adoption of this alternative in 2004.

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**Table 1. 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 | Surfclam 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 |

(Continued next page)

**Table 1. (continued)**

| Year | Class | Vessels | Trips | Hours at Sea | Hours Fishing | Surfclam 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 |
| 1998 | 1&2 | 11 | 736 | 10,558 | 5,633 | 764,551 | 136 | 69,505 |
| | 3 | 20 | 1,340 | 24,810 | 15,390 | 1,600,823 | 104 | 80,041 |
| | All | 31 | 2,076 | 35,368 | 21,023 | 2,365,374 | 113 | 76,302 |
| 1999 | 1&2 | 10 | 671 | 9,857 | 4,737 | 766,833 | 162 | 76,683 |
| | 3 | 23 | 1,484 | 26,019 | 15,214 | 1,771,046 | 116 | 77,002 |
| | All | 33 | 2,155 | 35,876 | 19,951 | 2,537,879 | 127 | 76,905 |
| 2000 | 1 | 3 | 57 | 979 | 392 | 15,869 | 40 | 5,290 |
| | 2 | 8 | 743 | 11,845 | 6,155 | 985,248 | 160 | 123,156 |
| | 3 | 20 | 1,241 | 21,755 | 13,360 | 1,559,904 | 117 | 77,995 |
| | All | 31 | 2,041 | 34,579 | 19,907 | 2,561,021 | 129 | 82,614 |

(Continued next page)

**Table 1. (continued)**

| Year | Class | Vessels | Trips | Hours at Sea | Hours Fishing | Surfclam Landings | LPUE* | Ave Bu/Boat |
|---|---|---|---|---|---|---|---|---|
| 2001 | 1&2 | 10 | 806 | 12,756 | 7,181 | 1,005,617 | 140 | 100,562 |
| | 3 | 25 | 1,584 | 28,233 | 17,694 | 1,849,549 | 105 | 73,982 |
| | All | 35 | 2,390 | 40,989 | 24,875 | 2,855,166 | 115 | 81,576 |
| 2002 | 1&2 | 9 | 850 | 14,782 | 8,813 | 1,055,835 | 120 | 117,315 |
| | 3 | 30 | 1,742 | 32,349 | 20,791 | 2,057,241 | 99 | 68,575 |
| | All | 39 | 2,592 | 47,131 | 29,604 | 3,113,076 | 105 | 79,822 |

* 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.

Source: NMFS Clam Vessel Logbook Files.

**Table 2. 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 | Quahog 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 |

(Continued next page)

**Table 2. (continued)**

| Year | Class | Vessels | Trips | Hours at Sea | Hours Fishing | Quahog Landings | LPUE* | Ave. Bu. per Boat |
|---|---|---|---|---|---|---|---|---|
| 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 |
| 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 |
| 1998 - Excludes Maine Fishery | | | | | | | | |
| | 1&2 | 5 | 375 | 11,491 | 6,371 | 587,228 | 92 | 117,446 |
| | 3 | 19 | 1,582 | 49,236 | 25,331 | 3,310,259 | 131 | 174,224 |
| | All | 24 | 1,957 | 60,727 | 31,702 | 3,897,487 | 123 | 162,395 |

(Continued next page)

**Table 2. Continued**

| Year | Class | Vessels | Trips | Hours at Sea | Hours Fishing | Quahog Landings | LPUE* | Ave. Bu. per Boat |
|---|---|---|---|---|---|---|---|---|
| 1999 - Excludes Maine Fishery | | | | | | | | |
| | 1&2 | 5 | 382 | 10,817 | 5,952 | 559,200 | 94 | 111,840 |
| | 3 | 18 | 1,696 | 50,612 | 25,748 | 3,211,088 | 125 | 178,394 |
| | All | 23 | 2,078 | 61,429 | 31,700 | 3,770,288 | 119 | 163,926 |
| 2000 - Excludes Maine Fishery | | | | | | | | |
| | 1&2 | 6 | 270 | 7,933 | 4,330 | 429,686 | 99 | 71,614 |
| | 3 | 23 | 1,541 | 48,369 | 24,110 | 2,730,963 | 113 | 118,738 |
| | All | 29 | 1,811 | 56,302 | 28,440 | 3,160,649 | 111 | 108,988 |
| 2001 - Excludes Maine Fishery | | | | | | | | |
| | 1&2 | 6 | 454 | 13,588 | 7,183 | 778,469 | 108 | 129,745 |
| | 3 | 24 | 1,654 | 51,637 | 26,702 | 2,912,538 | 109 | 121,356 |
| | All | 30 | 2,108 | 65,225 | 33,885 | 3,691,007 | 109 | 123,034 |
| 2002 - Excludes Maine Fishery | | | | | | | | |
| | 1&2 | 6 | 428 | 12,589 | 6,644 | 712,243 | 107 | 118,707 |
| | 3 | 25 | 1,559 | 49,424 | 23,979 | 3,158,407 | 132 | 126,336 |
| | All | 31 | 1,987 | 62,013 | 30,623 | 3,870,650 | 126 | 124,860 |

**Maine Ocean Quahog Fishery**

| Year | Class | Vessels | Trips | Hours at Sea | Hours Fishing | Quahog Landings | LPUE* | Ave. Bu. per Boat |
|---|---|---|---|---|---|---|---|---|
| 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 |
| 1998 | All | 39 | 1,820 | 18,452 | 11,777 | 72,466 | 6.2 | 1,858 |
| 1999 | All | 38 | 1,998 | 16,188 | 11,455 | 93,938 | 8.2 | 2,472 |
| 2000 | All | 34 | 2,197 | 18,015 | 12,739 | 120,767 | 9.5 | 3,552 |
| 2001 | All | 31 | 2,040 | 18,250 | 13,350 | 108,500 | 8.1 | 3,500 |
| 2002 | All | 35 | 2,604 | 23,724 | 16,967 | 128,574 | 7.6 | 3,674 |

NOTE 1: This table includes ocean quahog landings records from the Clam logbooks ONLY, and does NOT include landings submitted in the Multispecies logbooks until 1998.

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.

* 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