5.0 Description of the Environmental Impacts of the Management Alternatives

5.1 Introduction and Background

5.1.1 Organizational Structure of Impacts Assessment

There are two principal ways to organize the discussion of the environmental impacts of the management alternatives. The first structure organizes the discussion by impact type (biological impacts, economic impacts, social impacts, etc.) and includes the relevant analyses of all measures and alternatives under each type of impact. The discussion of each measure and each alternative would be repeated for each type of impact. This structure is usually most appropriate for Environmental Impact Statements (EIS) or lengthy Environmental Assessments (EA) when fairly well-developed technical analyses of the probable consequences are available.

The second organizational structure organizes the discussion by alternatives and includes the relevant biological, economic, social, etc., analyses under each alternative. This structure is usually most appropriate for a relatively short EA, but is useful when the availability of technical information on which to base the analyses is limited. This structure is also useful when we want to emphasize the distinctions between the alternatives. In the case of the Red Crab FMP, there were many management measures and alternatives to be analyzed. It is the intention of the Council to illustrate as clearly as possible the differences between the management alternatives under consideration. For most resource types (especially economic, social, and habitat), there is little technical information on which to base our analyses and our assessment of potential impacts will be largely qualitative. For these reasons (the desire to emphasize the alternatives and the limited technical information), this section is organized by alternatives and the analyses of the potential impacts on each resource type will be included in the discussion of each proposed measure and each potential management alternative.

In its consideration of a new management program for the red crab fishery, the Council intended to present a variety of ways the fishery could be managed (the management alternatives), each with a variety of specific tools to achieve the FMP goals and objectives (the management measures). Because each measure was developed with a range of options for the Council to consider, it would have been overly complicated to present only the analysis of impacts for the alternatives with the analysis of the impacts associated with the proposed measures and options within each alternative. Instead, the potential impacts associated with each proposed measure are provided first, and this analysis differentiates between the options within each measure. Then, the measures that constitute each alternative are discussed as a package and compared and contrasted with the two baselines identified for this FMP.

5.1.2 Biological and Ecological Impacts on Red Crab

The measures and alternatives considered in this FMP address a wide range of management issues. The potential biological and ecological impacts on the resource that

may result from these measures and alternatives will vary depending on the type of measure, the specific option selected, and the combination of measures that constitute the preferred alternative. This assessment will identify, to the extent possible, the potential biological and ecologic impacts to the red crab population comprising the management unit. The assessment will examine, where appropriate, whether the measures and alternatives are likely to contribute to or diminish the sustainability of the resource, whether the measures and alternatives are likely to alter the size structure of the population, changes in mortality expected as a result of the measures and alternatives, and whether the measures and alternatives are likely to have an affect on reproductive yield.

5.1.3 Ecological Impacts on Other Species and Communities

This section of the impacts assessment is intended to address any changes to the interactions of the deep-sea red crab with other species and their associated communities that may result from the implementation of this FMP. This section is also intended to identify and assess potential changes to the interactions of the directed red crab fishery with other species or their associated communities, usually reflected as bycatch in the primary fishery.

5.1.4 Impacts to Essential Fish Habitat

A description of the physical environment in which red crabs live and an assessment of the impacts to this habitat from fishing practices is provided in Section 8.2.3, the description of the resource and affected environment. All the alternatives and actions proposed in this FMP are intended to control and, in some cases, reduce the amount of fishing effort targeting deep-sea red crabs. The alternatives and actions proposed in this FMP, therefore, are unlikely to increase any adverse impacts to the EFH of any managed species that may be associated with the directed red crab fishery. This section of the impacts assessment will address the specific effects on habitat expected as a result of the particular measures and alternatives proposed for the FMP.

5.1.5 Economic Impacts on the Fishery

This section describes the economic impacts of the management measures that were considered for this FMP. The management alternatives represent the possible combinations of individual measures that together constitute a potential management program for the fishery. Each alternative includes a unique set of measures. The measures are the actual actions being considered to meet the goals and objectives of the plan. For example, a controlled access program is a specific type of management measure that may be used to address some of the problems in this fishery. Several of the management alternatives considered included a controlled access program as one of the measures.

The measures and alternatives considered in this FMP address a wide range of management issues. The potential economic impacts that may result from these measures and alternatives will vary depending on the type of measure, the specific option selected,

and the combination of measures that constitute the preferred alternative. The economic impacts of the proposed management measures can be felt by various sectors of the red crab fishing industry. These include harvesters, processors, fishery-dependent services, international trade, markets and fishing communities. The majority of the comments here will apply to either the harvesting or processing sector as they are the sectors that will be most influenced.

Few of these management measures would be effective alone. This section attempts to describe the economic impact of these individual measures. However, it is sometimes hard to think of one measure without thinking about its interaction with other measures that would either improve or decrease its effectiveness. Unfortunately, there are few economic data available with which to evaluate the potential economic impacts of the proposed management measures and alternatives to those individual and entities involved in the directed red crab fishery. As a result, the following discussion, at least as it pertains to economic impacts, is primarily a qualitative assessment of the likely impacts of the various measures and alternatives. A description of the affected human environment (red crab fishermen and fishing communities) is presented in Sections 8.4 and 8.5 of this FMP. A description of the available baseline social and economic information on the red crab fishery is provided in Appendix B.

5.1.6 Social/Cultural Impacts

This assessment characterizes to the extent possible the magnitude and extent of the social impacts likely to result from the proposed management action as well as from the other alternatives considered by the Council during the development of the Red Crab FMP. A description of the affected human environment (fishermen and communities) is presented in Sections 8.4 and 8.6 of this FMP. A description of the available baseline social and economic information on the red crab fishery is provided in Appendix B.

To the extent possible, the social impact factors described in the following subsections were considered relative to the management alternatives considered and were used as a basis for comparison between alternatives. While this assessment cannot quantify the impacts of the management alternatives on the following factors, discussion of the potential changes in the variables as a result of management actions provides information useful for better decision-making. The following factors were developed based in part upon the issues of concern identified by groundfish fishermen and their communities (NEFMC 2000a), tailored to represent the most significant issues of concern to red crab fishermen and their communities. While it is understood that there are differences among fisheries in what are perceived to be social impacts, there are some issues that are considered universal to all fisheries (i.e., safety at sea). These are not the only factors that could or should be considered, but they are largely indicative of the types of social issues that should be considered in the decision-making process. There may be other social issues which may affect fishermen and their communities, but they are even more difficult to define.

5.1.6.1 Social Impact Factor 1 -- Changes in Occupational Opportunities

This factor reflects the degree to which the implementation of the alternatives in this FMP could alter the occupational profile of the affected fishing communities

Changes in occupational opportunities can lead to changes in household/family income, classes, and lifestyles; in assessing this factor, both short-and long-term shifts in job opportunities should be considered. This includes changes to year-round and seasonal fishing opportunities, short-term and long-term dislocation from the fishery, employment opportunities, and the ability to find and keep experienced crew.

Emphasis should be placed on identifying potential changes in the unique social and family arrangements that characterize the communities under consideration, particularly on changes in household employment patterns, trends in family-run fishing businesses, and participation in job retraining programs. Special consideration should also be given to social and cultural values and norms that may be affected by changes in opportunity, such as long-term family involvement in the fishery, job satisfaction, and respect for fishing as an occupation and a way of life.

5.1.6.2 Social Impact Factor 2 -- Changes in Community Infrastructure

This factor reflects the increase or decrease in the demand and supply of basic infrastructure services and facilities essential to fishing in the affected communities, including processors, seafood markets, boat and equipment repair shops, bait and ice providers, display auctions, cooperatives, creditors, legal services, etc.

The cost, quality, availability, and location of fishing-related services can affect fishing community members' business practices, satisfaction with their community, and overall well-being. Additionally, these service industries provide alternative, fishing-related employment opportunities in port communities and contribute significant revenues to the county or city in which the fishing community is located. Impacts on this factor are directly connected to changes in industrial diversification and occupational opportunities. They are also more long-term in nature.

5.1.6.3 Social Impact Factor 3 -- Safety

This factor is related to the ability of fishermen to maintain safe operations at sea; safety can be compromised by various adaptations to increased regulations and decreased opportunity

The safety of fishermen and fishing operations at sea is an extremely important social impact issue, as decreased safety often increases stress at the individual and family level, which can exacerbate many other family and social problems. In addition, the impacts of fishing-related casualties can be felt throughout fishing communities, many of which are close-knit groups with longstanding family and social networks.

5.1.6.4 Social Impact Factor 4 -- Support for Management Program

This factor reflects the degree to which the participants of the fishery subject to the proposed regulations support the measures being proposed

Management measures that are more preferred or supported by the fishing industry sometimes encounter more success than measures that are opposed or that the industry feels are forced upon them. Some people believe that compliance with regulations is directly related to the degree of support for the regulations or faith that they will be effective in achieving their objectives.

5.1.6.5 Social Impact Factor 5 -- Flexibility/Stability/Uncertainty

This factor reflects the amount of flexibility retained by the participants of the fishery for making the day-to-day decisions that affect how, where, and when they fish. This factor also reflects the amount of stability the participants feel is provided by the fishery, or as the inverse, the amount of uncertainty they feel about their future participation in the fishery. These factors are considered together because they are often tightly interrelated.

Flexibility for the members of the fishing fleet and the ability to plan business ventures over the short-term and long-term is an important factor, as is the sense of control over their fishing activity. In an unregulated fishery, the vessel owners and operators have total control to determine when to fish and for how long, where to fish, and how they fish. Some of the measures proposed in this FMP may reduce the flexibility of the participants in the directed red crab fishery. Decreases in flexibility may result in increased stress levels felt by the fishermen and their families.

Having a sense of stability in their fishing activities and business is an important factor for all participants in the fishery. For vessel owners and operators, this is reflected in the desire to be able to plan their fishing year, including when to fish and when to service their vessel, the ability to retain trained crew members, and the ability to get an adequate price for their product. For crew members, stability is reflected in the desire to continue their employment and count on some basic level of earnings. For processors, this is reflected in the desire to have a steady supply of fresh product and the ability to maintain markets for their products. Most fishermen already face less stability in their jobs than do most other people; their income is determined largely by the amount of fish they catch and the prices they get for their fish. Any measures that reduce this sense of stability increases the uncertainty felt by the participants of the fishery.

5.1.7 Impacts on Protected Species

The description of the resource and affected environment section of this FMP (Section 8.7) provides a complete and comprehensive identification and description of all marine mammals and other protected species that may be found in the environment utilized by the red crab fishery. The following sections assessing the potential impacts of the proposed measures and alternatives focus on whether the proposed measures would be expected to provide benefits or have adverse impacts on the populations of marine

mammals and other protected species identified in Section 8.7.

5.2 Analysis of the Impacts of the Red Crab Management Program

This section will identify and describe the potential impacts associated with the elements of the fishery management program (management unit, fishing year, overfishing definition, etc.). This analysis will include a brief assessment of the most likely impacts that will result from the alternatives and options selected by the Council for implementation in the Red Crab FMP contrasted with the non-preferred alternatives. For those elements where there was not a range of alternatives considered by the Council (e.g., permitting and reporting requirements), only the potential impacts of the proposed program are included.

5.2.1 Fishery Management Unit

In general, selection of a management unit is not expected to have any direct biological, economic, or social impacts on the resource species or its fishery. The management unit establishes the boundaries within which the measures in the management plan will be implemented. The proposed boundary for the management unit (Cape Hatteras, North Carolina) includes the full extent of the directed fishery for deep-sea red crab in the northeastern U.S. This is expected to minimize all potential economic and social impacts that may affect the members of the directed fishery that will qualify for the controlled access program, as they will be assured that the red crab resource in the area of the traditional fishery will be protected from uncontrolled exploitation. The proposed boundary may have economic and/or social impacts on the incidental catch fishery as all vessels that retain red crab as incidental catch in other fisheries will be subject to the incidental catch restrictions in the FMP. Fishermen regulated under the South Atlantic Council's Golden Crab FMP may be affected by this management unit as it creates an overlap between the two management plans that could cause some confusion among these fishermen. Gear conflicts may arise between these two fishing groups, although even without the overlap in management units gear conflicts could arise. Without the force of the FMP, however, there would be no way for the Council to address any potential gear conflicts between the user groups.

There are no direct biological or ecological impacts expected as a result of the management unit set at Cape Hatteras, North Carolina, relative to the other alternatives considered by the Council. The primary indirect impact is the establishment of the area within which the management measures intended to protect and conserve the red crab resource will be implemented. A smaller management unit (i.e., one of the non-preferred alternatives) would result in more of the red crab resource outside the management jurisdiction and therefore subject to overexploitation. The only habitat issue related to the identification of the management unit is to establish the range within which essential fish habitat (EFH) may be designated for red crab. Selecting the broadest management unit results in larger EFH designations relative to what the designations would have been under one of the non-preferred alternatives. There are no impacts expected to any protected species as a result of the identification of a management unit.

5.2.2 Fishing Year

In general, selection of a fishing year start date is not expected to have any direct biological, economic, or social impacts on the resource species or its fishery. There may have been indirect economic and/or social impacts on the participants of the fishery if the start date was chosen to occur at a time of low productivity, poor conditions, and/or low demand and, due to the nature of the management scheme (e.g., a program that encouraged a derby-style fishery), fishing effort increased to levels above those which would occur if the fishing year began at another time. These potential concerns should be mitigated in two ways. First, the overall management scheme was selected as an attempt to minimize the potential for creating a derby-style fishery. The use of a days-at-sea program with a target TAC provides no incentive for a fisherman to fish during time of poor conditions, reduced product quality or decreased demand. Fishermen will be able to hold their DAS to fish during the best times without any concern over losing the ability to fish for red crab. Second, the fishing year will begin at a time of traditionally increasing rather than decreasing landings (see Figure 3). Available data suggest that absent any management controls, landings of red crab increase after March 1 relative to other times of the year; thus, red crab fishermen will be allocated their annual DAS at a time when they would normally increase their fishing effort.

There are no reasons to believe that the selection of a fishing year start date would have any biological or ecological impacts on the red crab resource or associated species. The intent of the overall management plan is to maintain a directed red crab fishery for all twelve months of the year. Fishing effort should therefore be evenly distributed throughout the year and not directly linked to a particular fishing year start date. There are no impacts expected to essential fish habitat or any protected species as a result of the identification of a start date for the fishing year.

5.2.3 Commercial Biomass and MSY

The biological impacts to red crab associated with the estimation of commercial biomass and the calculation of MSY are described in Section 3.4. Economic and/or social impacts associated with this element of the FMP may stem from the results (e.g., the more conservatively biomass and MSY are estimated, the less red crab will be available to the fishery for harvest), but the Magnuson-Stevens Act requires that commercial biomass and MSY be determined solely on biological factors and the limits of the resource, not on potential economic and/or social impacts that may result from a more or less conservative estimate of MSY. There are no impacts expected to essential fish habitat or any protected species as a result of the estimation of commercial biomass and the calculation of MSY for the red crab resource.

5.2.4 Overfishing Definition

The biological impacts to red crab associated with the development of an overfishing definition are discussed in Section 3.5. Economic and/or social impacts associated with this element of the FMP may stem from the results (e.g., if a stock is determined to be overfished or if overfishing is occurring, fishing effort will have to be

reduced), but the Magnuson-Stevens Act requires that the overfishing definition be determined solely on biological factors, the limits of the resource and on the available information, not on potential economic and/or social impacts that may result. There are no impacts expected to essential fish habitat or any protected species as a result of the selection of an overfishing definition for the red crab resource.

5.2.5 Optimum Yield

According to the Magnuson-Stevens Act, the specification of optimum yield (OY) is intended to incorporate economic, social and ecological factors, yet never exceed MSY. These are described in Section 3.6. The preferred alternative selected by the Council is intended to best incorporate these factors into the specification of OY for the red crab fishery. There are no direct impacts expected to essential fish habitat or any protected species as a result of the specification of OY for the red crab fishery.

5.2.6 Essential Fish Habitat

In general, the identification and description of essential fish habitat (EFH) is not expected to have any direct biological, economic, or social impacts on the resource species or its fishery. There may be impacts associated with any management measures that may be implemented to conserve and protect EFH, but these impacts are more appropriately identified and analyzed under the particular management measures themselves. The only impacts expected as a result of the proposed EFH designations are to the habitat itself. The designation of EFH provides an explicit mechanism to be used to facilitate the protection of EFH, from either fishing or non-fishing related activities. Without this designation, this protection is not possible. There are no impacts expected to any protected species as a result of the designation of EFH for red crabs.

5.2.7 Permits and Reporting Requirements

The development of a permitting program and reporting requirements for the red crab fishery is not expected to have any biological or ecological impacts on the red crab resource or associated species. The proposed permitting program and reporting requirements will have economic impacts on the participants of the red crab fishery who must comply with these new requirements in order to continue their participation. Direct economic impacts are expected associated with the time needed by fishery participants to apply for the required permits and maintain and submit the required reports on catch, landings, and purchases of red crab and associated species (all fishermen permitted under the Red Crab FMP are required to report discards and bycatch as well as red crab landings). Based on the information provided to comply with the requirements of the Paperwork Reduction Act (PRA), the following estimated annual costs are expected to be borne by the participants of the red crab fishery:

Controlled Access Directed Red Crab Fishery

1. Permitting = $45.00 per participant to apply for all required permits.

2. Reporting = $40.00 per participant to comply with reporting requirements.

Open Access Incidental Catch Fishery

1. Permitting = $16.00 per participant to apply for all required permits.

2. Reporting = $15.00 per participant to comply with reporting requirements.

Red Crab Dealers and Processors

1. Permitting = $2.00 per participant to apply for all required permits.

2. Reporting = $130.00 per participant to comply with reporting requirements.

Considering that the average annual expenses for members of the directed fishery are estimated at $397,000 (see Section 8.5.1 on the baseline economic characteristics of the fishery), the direct economic impacts on fishery participants as a result of the proposed permit program and reporting requirements are relatively insignificant. The social impacts are similarly expected to be relatively insignificant to the participants of the red crab fishery, and all social and economic impacts are offset by the benefits of being able to continue their participation in the red crab fishery by complying with these requirements. There are no impacts expected to essential fish habitat or any protected species as a result of the permitting program and reporting requirements proposed for the red crab fishery.

5.3 Analysis of the Impacts of the Management Measures and Options

This section will identify and describe the potential impacts associated with each management measure considered in the Red Crab FMP. The analysis of impacts will consider each potential measure separately and independently of the other potential management measures, except in the case of measures that can only work in concert with one another. In this limited case, the set of measures that can only work in concert with one another will be considered as a group. The analysis in this section will serve as a baseline for the analysis in the following section, which will compare and contrast the potential impacts of the ten proposed management alternatives. Please see Section 4.2 for a full description of all proposed management measures, the options contained within each measure, and the sets of management measures comprising the alternatives considered by the Council.

5.3.1 Incidental Catch Limit

This measure will establish limits on the amount of deep-sea red crab that may be landed by any vessel not authorized to participate in the controlled access directed red crab fishery.

5.3.1.1 Biological and Ecological Impacts of the Measure on Red Crab

Directed red crab trips frequently land over 40,000 pounds per trip. Other trips land relatively small amounts of red crab (100 pounds to a few thousand pounds) as incidental catch. A measure to allow incidental catch will allow fishermen from other

fisheries to retain a fixed amount of red crabs per trip. If the limit is set low enough, incidental catches will not have a significant impact on the red crab stock. If the incidental catch limit per trip is set high, then the quota for the directed fishery could be reduced to result in no net additional impact on the red crabs. Based on the NMFS database, total reported incidental catches from 1998, 1999 and 2000 were 13,619, 35,517 and 56,187 pounds, respectively. These are likely to be underestimates, given the limited quality of this database for historical red crab landings. Figure 14 displays the frequency distribution of non-directed red crab fishing trips with some amount of red crab landings during 1998 - 2000. Dealer weigh-out and VTR data provided by NMFS on incidental catch of red crab from 1998 to 2000 were analyzed to determine the percentage of trips that would likely be affected by the options under consideration.

Between 1998 and 2000, there were a total of 263 reported trips that landed an annual average of 35,108 pounds of red crab. Table 15 reports the percentage of these trips that would be accounted for by each of the options under consideration for an incidental catch limit and the expected percentage of trips that would be affected by each option. The lowest incidental catch limit option (50 pounds per trip) would be expected to account for approximately 25% of all trips (26.6% in 1998 - 2000) and would be expected to affect approximately 75% of all non-directed fishing trips. Setting the incidental catch limit at 100 pounds per trip would be expected to account for approximately 40% of all trips (38.4% in 1998 - 2000) and therefore affect about 60% of all trips. Increasing the incidental catch limit to the 500 pounds per trip option would be expected to account for nearly 75% of all trips (72.6% in 1998 - 2000) and would be expected to affect approximately 25% of trips. Setting an incidental catch limit of 1,000 pounds per trip would account for most (88.6% in 1998 - 2000) trips reporting some landings of red crab and would only affect approximately 10 - 12% of all trips.

Incidental catch can be monitored and the effect it has on the fishing mortality rate can be measured. Discarding of red crabs, which are neither targeted nor landed, is distinct from incidental catch. The impact of discarding red crabs is more difficult to estimate, but could be larger than that of incidental catches. The magnitude of discarding has not been measured, and the fraction of discarded red crabs that survive and reproduce is not known. The way they are captured, handled and released at the surface is certain to affect their survival rate. Red crabs are very sensitive to injury (Gray 1970), which raises concern about discard mortality. Almost any damage, such as a crushed periopod or cracked claw, will cause mortality. Fishing with crab traps causes much less injury to crabs than using otter trawls. It is difficult to return crabs to the sea floor after they have been exposed to air for an extended period (Ganz and Herrmann 1975) because they float on the surface rather than sinking back to the bottom.

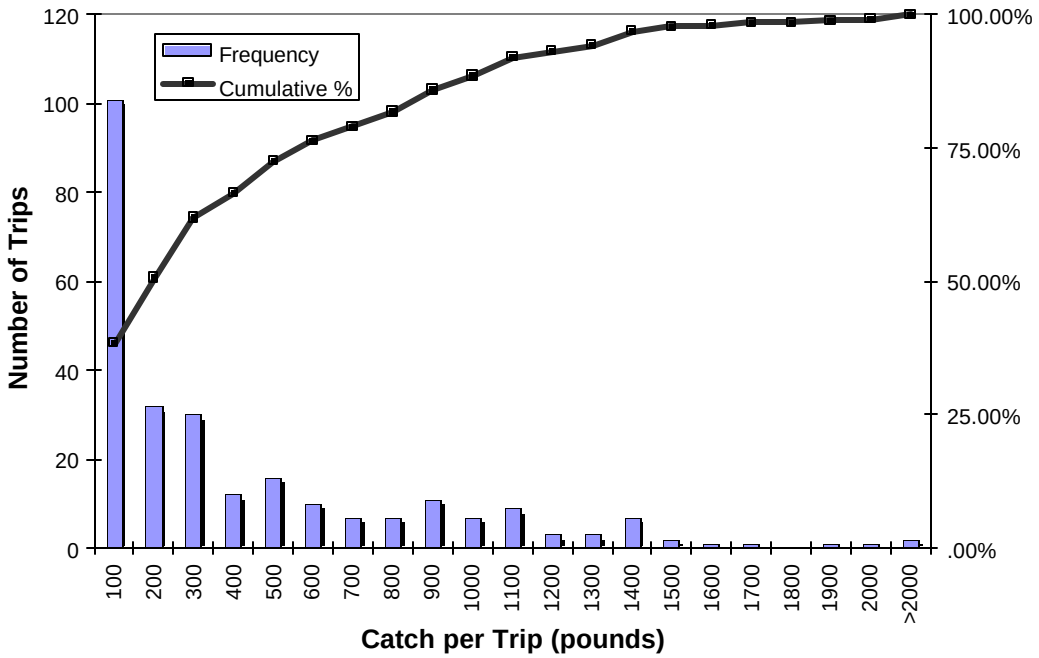

Figure 14: Incidental catch of red crab on non-directed fishing trips, 1998 - 2000.

Incidental Catch Limit Options	Cumulative Percentage of Trips Taken	Percentage of Trips Affected
50 pounds per trip	26.6%	73.4%
100 pounds per trip	38.4%	61.6%
500 pounds per trip	72.6%	27.4%
1,000 pounds per trip	88.6%	11.4%

Table 15: Cumulative percentage of number of fishing trips with proposed incidental catch limit or less of red crab, based on 1998 - 2000 data.

5.3.1.2 Ecological Impacts of the Measure on Other Species and Communities

Because this measure does not apply to the controlled access directed red crab fishery, and only applies to participants of other fisheries that may have some incidental catch of red crab, this measure would not be expected to have any direct effect on other species or their communities. There are no beneficial effects possible unless the limit selected would reduce the level of non-red crab vessel fishing effort. Adverse impacts are possible if the incidental catch limit selected would significantly increase the participation level of non-red crab vessels.

5.3.1.3 Impacts of the Measure to Essential Fish Habitat

This measure proposes to restrict the landings of red crab by vessels not authorized to participate in the controlled access directed red crab fishery that have incidental catch

of red crabs. Because this measure only affects the amount of red crab landings by vessels not participating in the directed red crab fishery, it will have no effect on the essential fish habitat (EFH) of any resource species managed by the New England, Mid-Atlantic, or South Atlantic Fishery Management Councils, or NMFS under the highly migratory species FMPs.

Generally, the implementation of trip limits of any kind (including incidental catch limits) would not be expected to have a direct effect on the habitat of the region. Trip limits could have an indirect effect on the habitat of the Northeast by controlling the amount of fishing effort associated with the fishery, assuming that fishing effort ceases as soon as the trip limit is reached and does not continue with the intent of "high-grading." However, in the case of an incidental catch limit where the targeted species is not managed under this FMP nor is affected by this action, indirect effects on the habitat are also unlikely.

5.3.1.4 Economic Impacts of the Measure on the Fishery

This measure only applies to participants of other fisheries not authorized to participate in the controlled access directed red crab fishery that may have some incidental catch of red crab; therefore, this measure will not affect the harvesting sector of the directed red crab fishery. All of the alternatives include some allowance for incidental catch, so this measure would not be one that would be the deciding factor for one alternative over another.

This measure may have an effect on harvesters participating in other fisheries who sometimes land red crabs, but the extent of the impact depends entirely upon the incidental catch limit that is selected. The FMP includes several options for setting incidental catch levels. The preferred alternative recognizes an incidental catch of 500 pounds per trip, consistently over the course of the year. This would ensure that the offshore lobster fishery, as well as other fisheries, would be able to continue to land relatively small amounts of red crab as an incidental catch in their primary fisheries.

Figure 14 displays the frequency distribution of non-directed red crab fishing trips with some amount of red crab landings during 1998 through 2000. Dealer weigh-out and VTR data provided by NMFS on incidental catch of red crab from 1998 - 2000 were analyzed to determine the percentage of trips that would likely be affected by the options under consideration.

For non-red crab directed trips (n=263 trips; VTR and weighout database) that landed red crabs between 1998 and 2000, the average catch was 400 pounds and the median catch was 200 pounds. Thirty-eight percent of the trips took less than 100 pounds, fifty percent took less than 200 pounds, seventy-six percent of the trips took less than 600 pounds, and eighty-eight percent of the trips took less than 1,000 pounds. Total incidental catch of red crab in 1998 (13,619 pounds), 1999 (35,517 pounds) and 2000 (56,187 pounds) average to 35,108 pounds per year. Given the poor quality of the database, this is very likely to be an underestimate. It is also interesting to note the incremental increase that occurred in total incidental catch during the three years.

Table 15 reports the percentage of these trips that would be accounted for by each of the options under consideration for an incidental catch limit and the expected percentage of trips that would be affected by each option. The economic impacts of the proposed incidental catch limit options will only be felt by those vessels no longer able to retain as much red crab as they previously would have, and then only to the degree that their landings are reduced. For example, the proposed catch limit of 500 pounds per trip (the preferred alternative), would have affected 27.4% of the trips taken in 1998-2000 (there were 72 individual trips taken in 1998-2000 with more than 500 pounds of red crab as incidental catch). The average red crab landings of these trips were approximately 1,040 pounds. Since these trips would have been allowed to retain 500 pounds of red crab, this results in an average loss of 540 pounds of red crabs per trip. Assuming that one third of these trips were taken in each year, there would have been 24 trips per year with an average loss of 540 pounds per trip. Assuming the red crabs could be sold for as much as $1.00 per pound (this is likely to be an overestimate), there would have been a total loss of potential revenue of approximately $12,960 per year for all vessels combined.

This analysis assumes that all the red crab landed as incidental catch is sold for additional revenue. However, in many cases, it is likely that the retained red crabs are not sold but are distributed among the crew of the fishing vessels for their personal consumption. In these cases, the direct economic impacts will be less. Thus, overall it appears that the economic impacts of the proposed incidental catch limit will be minimal.

Tiered incidental catch limits would provide for a different level of incidental catch for certain vessels that participate in a fishery with a tradition of higher red crab landings during winter months. Those vessels holding a valid Area 3 Lobster Permit would be allowed to retain and land up to a maximum of 1,000 pounds of red crab per fishing trip during the months of December, January, and February only. The rest of the year, these vessels, as well as all other vessels not fishing on a directed red crab trip, would be allowed to retain and land up to a maximum of 100 pounds of red crab per fishing trip. Both levels of incidental catch limits under this option are potentially subject to other regulations. In public comment, it was suggested that 6 months from November through April represent the time when red crab is typically caught by offshore lobstermen.

In calendar year 2000, December, January and February accounted for 11%, 3% and 7% of red crab revenue, as recorded in NMFS dealer data. September, October, and November accounted for the largest revenue per month from red crab, with 13%, 14% and 12%, respectively.

The degree to which the incidental catch of red crabs by vessels not participating in the controlled access directed red crab fishery contributes to the annual revenues of the processing sector is unknown, but is unlikely to be significant. According to both dealer and VTR reports, there were a total of 139 trips in calendar year 2000 that landed an average of 404 pounds of red crab per trip. Approximately 56,200 total pounds were landed in 2000 by those not in the directed fishery. This breaks down to roughly 4,700 pounds per month and, if we assume an equal split of the landings among the four known processors of red crab product, just under 1,200 pounds per month per processor.

Given that the vessels participating in the directed red crab fishery routinely land an average of 60,000 pounds of red crab per trip, the potential loss to the processors of some portion of approximately 1,200 pounds per month would not be significant (remember that we will not be eliminating the incidental catch, simply capping the amount of incidental catch that may be landed on each trip, so some amount of incidental catch would still be coming in from the non-directed component of the fishery).

There are no economic impacts to fishery-dependent service industries, such as fuel, ice, bait, and gear suppliers expected as a result of this proposed measure. This measure does not affect the directed red crab fishery and only affects the non-directed component of the red crab fishery to a minor degree. Because of this, the primary fishing activities of the non-directed component of the fishery would continue and it is anticipated that their use of the fishery-dependent service industries would continue unchanged.

There are no economic impacts to markets for red crab expected as a result of this proposed measure. This measure does not affect the directed red crab fishery and only affects the non-directed component of the fishery to the extent of placing per trip limits on the amount of red crab they may land as incidental catch. The relatively small amount of red crab landed by those vessels with landings of red crab as incidental catch is insignificant compared to the landings of the directed red crab fishery. For example, in 2000, all vessels with incidental catch of red crab landed a total of 56,187 pounds of red crab. This equates to approximately what one vessel in the directed red crab fishery lands on each trip.

There are no known economic impacts to fishing communities expected as a result of this proposed measure. There are no communities dependent upon either the directed red crab fishery or the non-directed component of the fishery. While the survey concentrated solely on the directed red crab fishery, the analysis of National Standard 8 (see Section 7.1) deals with both the directed and the non-directed component of the fishery.

More information on the non-directed fleet, consisting of both lobster vessels and otter trawlers can be found in Section 5.3.6.4 under gear restrictions. The analysis done on incidental catch of red crab (Section 5.3.1) was done using both weigh-out and VTR data from the years 1998 to 2000.

5.3.1.5 Social/Cultural Impacts of the Measure

This measure only applies to participants of other fisheries not authorized to participate in the controlled access directed red crab fishery that may have some incidental catch of red crab; therefore, this measure will not affect the harvesting sector of the directed red crab fishery or their communities. It is unlikely, given the relatively minor economic impacts to fisherman harvesting incidental catch levels of red crab expected from this measure (see above), that this measure would have any noticeable social impacts on these fishermen or their communities.

This proposed measure is not expected to have any effect on the occupational opportunities of any participants of the directed or non-directed components of the red crab fishery. The proposed measure is not expected to have any effects on community infrastructure, or the safety of any fishery participants. There appears to be general support for this type of measure among the participants in the fishery, and this measure is not expected to decrease the flexibility or stability, or increase the uncertainty, of any participants in the fishery.

5.3.1.6 Impacts of the Measure on Protected Species

There are no beneficial effects to protected species expected with proposed 500 pound incidental catch limit, due to the fact that a significant reduction in the level of non-red crab vessel fishing effort is not anticipated at that level of incidental catch. However, any limitation in the incidental catch will serve to minimize the participation level of non-red crab vessels. Approximately 25% of non-red crab vessel trips will be affected by the 500 pound limit, thus restricting expansion of fixed gear in the red crab fishing areas that may result from vessels not participating in the red crab fishery.

5.3.2 Minimum Size Limit

This measure proposed establishing a regulatory minimum size for all red crabs landed in the directed red crab fishery.

5.3.2.1 Biological and Ecological Impacts of the Measure on Red Crab

This measure proposed limiting the harvest of red crabs to individuals greater than or equal to a certain carapace width (CW). According to the early NMFS stock assessment for the Northeast U.S. fishery (Serchuk 1977), "Landings consist only of male crabs with a minimum carapace width of 4 ½ inches (114 mm)." Size limits considered at this time were 4 inches (102 mm), 4 ¼ inches (108 mm), and 4 ½ inches (114 mm) CW. The carapace width is the distance between the tips of spine number five on the carapace.

Wigley et al. (1975) carried out a survey of red crabs between Georges Bank and Virginia in 1974, and estimated a total red crab biomass of 116,512,000 pounds (52,864,000 kg). The survey included a part of Georges Bank now in Canadian waters, and excluded a region between Virginia and Cape Hatteras, North Carolina. Data from the Wigley survey were reanalyzed to compute the percent of total biomass above particular size limits, for both sexes and for males only (see Table 16). Harvesting crabs above 4 ½ inches (114 mm) would ensure that the majority of the landed crabs are males, thus preserving female spawning crabs (see Figure 15).

Male Carapace Width Minimum Size Limit	Female Carapace Width Minimum Size Limit	Percent of Total Biomass Greater Than/Equal To Minimum Size Limit
4”	4”	78.1%
4 ¼”	4 ¼”	65.6%
4 ½”	4 ½”	50.5%
4”	Male-only	62.3%
4 ¼”	Male-only	58.4%
4 ½”	Male-only	47.8%

Table 16: Percent of total red crab biomass that is exploitable under the different options associated with this measure.

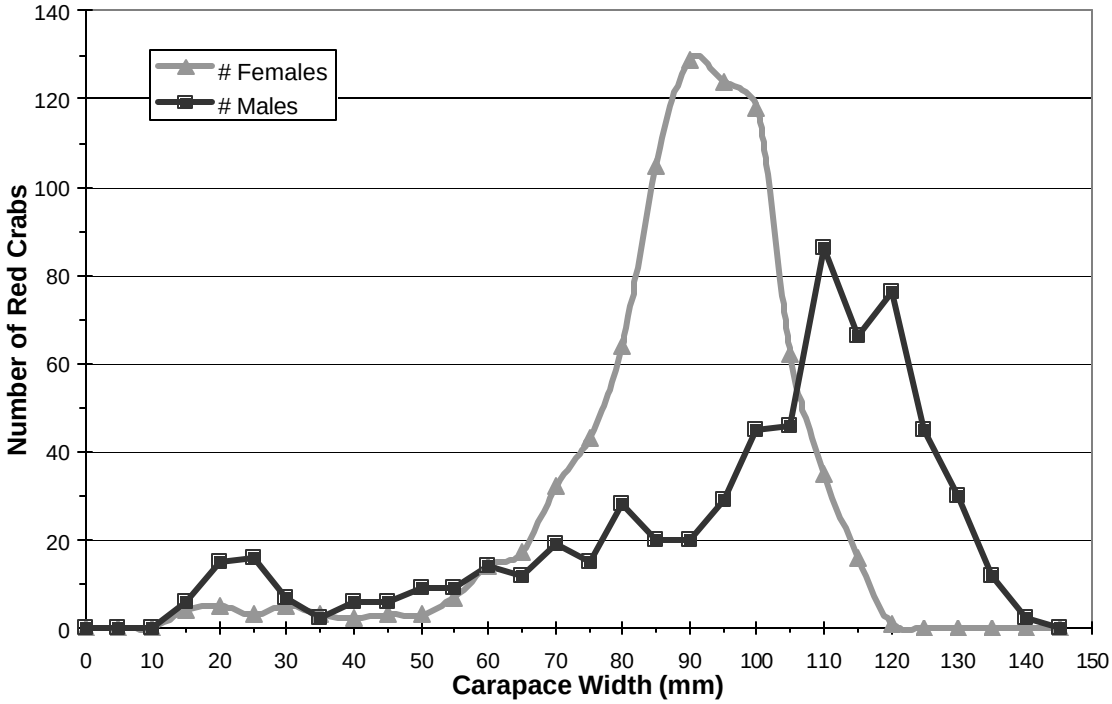

Figure 15: Male and female red crab length frequency from Wigley et al. survey (1975), showing that in this survey there were more but smaller females than males.

Due to market constraints, the traditional vessels reportedly retain only large male crabs, so they are already practicing this measure to some degree. The traditional market is for crabs averaging over one pound, and this is best met by large male crabs. For a given carapace width, females are less desirable because they generally do not weigh as much as males (see Figure 16). Because catcher-processor vessels may be able to process crabs on-board, they may not be restricted in the same way as other vessels by these market forces, and may have some incentive to retain and process smaller crabs,

including females. This type of measure would be difficult to enforce at sea, as it would be nearly impossible to determine the make-up of the crab harvest (i.e., the size and sex of the crabs that are processed at sea) of processing vessels. Butchering crabs at sea, where the carapace is removed and the crab is cut in half laterally, will also make any proposed regulatory minimum size very difficult, if not impossible, to enforce.

Regardless of whether or not it can be enforced, a minimum body size limit for landing red crab could be advantageous to the fishery and to the red crab stock. From a yield perspective, crab biomass increases non-linearly with CW. Thus, yield per crab is much greater if that individual is large. For example, 4 inch (102 mm) and 4 ½ inch (114 mm) CW crabs from Nova Scotia weigh only 0.8 pounds (370 grams) and 1.0 pounds (450 grams) on average, respectively (Meade and Gray 1973). By comparison, crabs of 5 inch (127 mm) and 5 ½ inch (140 mm) CW weigh 1.3 pounds (600 grams) and 2.0 pounds (900 grams) on average, respectively. These red crab weights are similar to those from male red crabs of comparable CWs collected in deep water off southern New England in the 1970s (Farlow 1980, see Figure 16) and in 2001 by NMFS.

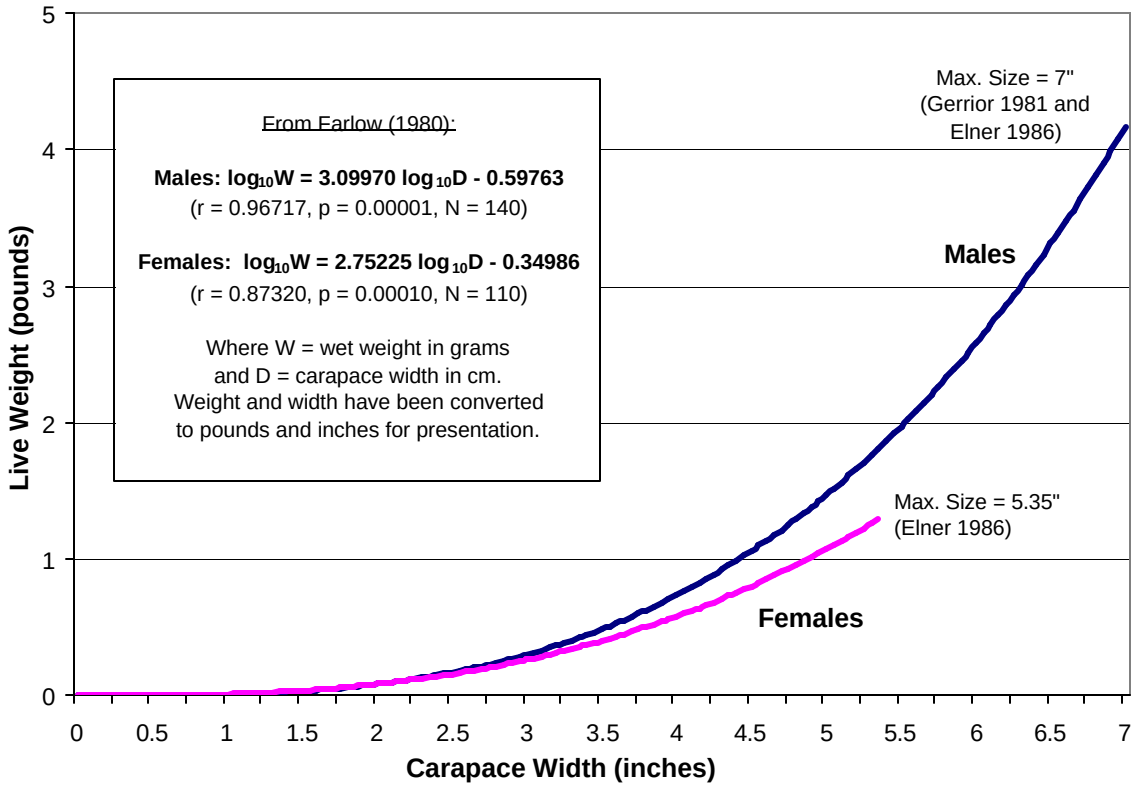

Figure 16: Widths and weights of red crabs (males and females), based on size-weight relationships derived by Farlow (1980).

An advantage of a minimum size in the range of 4 to 4 ½ inches (102 - 114 mm) CW is that it would allow both male and female crabs to mature and reproduce at least once. As with most decapods, the eggs of the female red crab are attached to the pleopods under the abdominal flap until the eggs hatch and larvae are released into the

water column. The minimum carapace width for females carrying eggs is 87 mm in southern New England, 64 mm in the Gulf of Maine (Ganz and Herman 1975), and 80 – 91 mm in Norfolk Canyon (Haefner 1977). Several studies found ovigerous females ranging in size between 80 – 130 mm (Wigley et al. 1975; Haefner 1977; Hines 1988; Steimle et al. 2001). Male red crabs have distinguishing reproductive structures when they are quite small (~70 mm), but the size when they can mate successfully may be considerably larger (Lawton and Duggan 1998; Fernandez-Vergaz 2000). Because males and females are often segregated by depth (Stone and Bailey 1980), and because males tend to grow larger than females, it should be possible to target the large males with little impact on the smaller females.

There are some possible disadvantages to a size limit. A fishery directed on the largest individuals in a population might alter the life history of the species over time (e.g., eliminating faster growers). It can also truncate the age and size structure (Barry and Tegner 1989; Kruse et al. 2000); thus, increasing the percentage of first-time breeders (see discussion below in section on Male-Only Fishery). Due to a lack of biological information, it is difficult to say whether either of these effects is likely to occur if a 4 ½ inch (114 mm) size limit were imposed on red crabs. Finally, discard mortality on small or marginal-sized female crabs could increase under a minimum size limit (although since these crabs are currently not landed, fishing practices would not be expected to change and there should be no change in mortality).

These issues were considered in a recent analysis of the male-only, red king crab (*Paralithodes camtschaticus*) fishery in Alaska (Kruse et al. 2000). Specifically, they examined whether to reduce the size limit from 165 mm to 152 mm CW. The 165 mm size limit was originally set based on market controls and to allow males at least one mating opportunity (although the sizes of red king crabs are larger than those of red crabs, this situation is similar to the traditional red crab fishery in the Atlantic which has had a self-imposed rule to take only large males). Kruse et al. (2000) concluded that it is better to maintain the higher (165 mm) size limit for red king crab. The results of the analysis were sensitive to the assumed mortality caused by handling and returning of crabs to the ocean, which Kruse et al. (2000) assumed to be 20% in their base case.

Some of the *advantages* of switching to a smaller size limit would have included: lower discard mortality of red king crabs; increased proportion of legal crabs in the catch; and increased catch in numbers of legal crabs per haul in the short-term. Some *disadvantages* of switching to a smaller size limit would have included: decreased yield per legal crab; decreased steady-state (equilibrium) yield from the stock; the population would have a higher percentage of first-time breeders; and an economic break-even analysis showed that it would take several decades for cumulative catch under the smaller size limit to exceed the cumulative catch under the larger size limit. Importantly, the authors noted that net benefits of the reduced size limit would accrue more quickly if the true handling mortality was greater than the assumed value (20%).

There are no definitive estimates of "handling" mortality for the deep-sea red crab in the Atlantic. This is problematic for managers because, as shown by Kruse et al. (2000), this parameter is of major importance in determining the appropriate size limit. It

is known that red crabs are often damaged in fishing nets, but are less likely to be damaged in pots. They are very sensitive to damage, which may cause them to die. Capturing and releasing red crabs exposes them to a number of additional risks and stresses. These include physiological stress from exposure to air, changes in temperature and pressure, predators in the water column, and displacement from the original home range to a new location which may not be as suitable for survival, feeding and/or mating. To get an accurate estimate of the migration patterns of deep-sea red crab off the coast of Africa, Melville-Smith (1987) developed a special cage to safely lower the crabs to the bottom after they had been tagged. This extra precaution appeared to increase survival, as indicated by the greater rate of recovery of tagged crabs in years when the special cage was used. Other factors, such as greater awareness by fishermen to return tagged crabs, may have also caused the recovery rate to go up.

It should be stressed that removing too many large males from the population could disturb courtship and mating (Elner et al. 1987), which may reduce female fecundity. Imposing a minimum size limit would be the most direct way to maintain males that are capable of mating with the largest females in the population.

5.3.2.2 Ecological Impacts of the Measure on Other Species and Communities

Very little is known about the interactions of the deep-sea red crab with other species and their associated communities. The directed red crab fishery has no known interactions with other species or their associated communities, as the bycatch of other species in the red crab fishery is minimal. The impacts of this fishery on other species or their communities are expected to be minimal to non-existent. This proposed measure would not affect this conclusion.

If new information becomes available that suggests this conclusion may be incorrect, the Council will review the information and consider whether or not additional action may be necessary. Future assessments of this type will consider all new information regarding the interactions of the red crab fishery with other species and their communities and consider mitigation, if necessary, at the appropriate time.

5.3.2.3 Impacts of the Measure to Essential Fish Habitat

Measures that do not directly reduce fishing effort by a gear type associated with adverse impacts to EFH, but rather manage the sex or size class of fish or invertebrates targeted by the industry, such as with the minimum size limits proposed in this measure, would not be expected to have a direct effect on the habitat of the region.

5.3.2.4 Economic Impacts of the Measure on the Fishery

The preferred alternative of this FMP would not enforce a minimum size in the red crab fishery. Other alternatives considered different limits and restrictions. There are several issues related to the implementation and enforcement of these types of measures. For instance, how to establish a minimum size limit (usually based on carapace width) if butchering or processing at sea is allowed. Depending on whether and the degree to which the Council allows or restricts processing and/or butchering at sea, weight-based

minimum size restrictions would be developed, based on conversion factors. A significant issue for the Council will be the utility of a minimum size limit relative to the difficulty of enforcement and actual conservation benefit. The market largely controls the size of the crab that is efficient to process and sell, and so far this seems to be about a minimum of a one pound crab. There is evidence that a one pound red crab is equivalent to a 4.2" carapace width (Meade 1973, Farlow 1980). Other studies have specified a 4" CW crab as the minimum required for the market. Obviously, this difference between a 4" and a 4.2" market size has repercussions for this measure.

If we accept that the market will control the size of the crabs landed, implementation of a regulated minimum size may be unnecessary, especially given the enforcement concerns. If market conditions changed, or small crabs were being landed and/or processed in increasing numbers, the Council could adopt a minimum size limit in the future via a framework adjustment to the FMP. A minimum carapace width restriction (and thus the male only restriction) would appear to have minimal economic impact on the vessels that bring back live crabs.

It may not be practical to implement a regulatory minimum size in this fishery if any type of butchering and/or processing of red crabs at sea is permitted. The nature of the butchering process (removal of the carapace and the cutting of the crab in half laterally) makes it all but impossible to administer and enforce a minimum size regulation. With full processing at sea (removal of the meat from the body of the crab), it would be completely impossible to enforce this type of regulation. It may not be necessary to regulate a minimum size for red crabs at this time since the market for red crabs is fairly restrictive. As long as these market conditions remains, a complicated and difficult to enforce regulatory minimum size may be superfluous and unnecessary.

Because the catcher-processor vessels may have processing capability on-board, they may not be restricted in the same way by market forces, and may have some incentive to retain and process smaller crabs, including females. Nevertheless, none of the freezer-processors fishing for red crab at present reportedly has a centrifuge on board which is used to separate meat from shell and that could provide an incentive to process small crabs. There is some concern that these vessels could obtain a centrifuge in the future. If this did occur, there would be no incentive by these vessels to avoid smaller crabs. Currently, there is no reason for these vessels to take any size crab other than large crabs consistent with those taken by vessels that have fished historically. Furthermore, this type of measure would be difficult to enforce at sea, since it would be nearly impossible to determine the make-up of the crab harvest (i.e., the size and sex of the crabs that are processed at sea) of processing vessels.

There would be no economic benefits to offset the additional cost of enforcing a minimum size restriction. There would be no economic impacts to the shore-based processing sector due to the minimum size, since the sector is currently already self regulated to accept only a certain size crab. Because of the difficulty for enforcement posed by the relationship between processing at sea and minimum size requirements, the processor portion of the catcher/processor vessels may be affected by this measure. If there is a minimum size requirement, there may also be corresponding prohibitions of

processing at sea that may have adverse effects on the larger catcher/processor vessels and their crews.

The minimum size restriction alone would not cause economic impacts to fishery-dependent service industries. The minimum size restriction used with other measures may cause impacts, but they would be caused by the other measures, and not solely due to this measure. Since the markets tend to enforce a minimum size, there would be no impacts to markets for red crab expected as a result of this proposed measure. There are no known economic impacts to fishing communities expected as a result of this proposed measure, as the measure itself is expected to be self-enforcing.

5.3.2.5 Social/Cultural Impacts of the Measure

There are no data available with which to evaluate the potential impacts of this measure on the social and cultural aspects of New England and Mid-Atlantic fishing communities. The small size, few participants, and distributed nature of this fishery, however, suggests that any social or cultural impacts to these fishing communities will be negligible. For example, there is one red crab vessel based in Gloucester, Massachusetts. Relative to the other fishing activities based in Gloucester, any impacts to this red crab vessel, its owners and operators, crew, fishing-related support services, and their families, that arise as a result of the measures proposed in this FMP are unlikely to significantly affect the community of Gloucester.

Based on information provided by members of the red crab fishing industry in response to a survey collecting baseline information on the fishery, few consider the communities in which they live to be fishing communities, and fewer still consider their communities to be significantly dependent upon fishing activities (see Appendix B). The implementation of new management programs for the red crab fishery, therefore, would not be expected to significantly disrupt the social frameworks of these communities.

This measure is unlikely to change current fishing practices in the directed red crab fishery. This fishery, although currently not subject to an FMP, already operates by harvesting only male crabs larger than four inches carapace width. Assuming that this measure will not substantially alter that practice, which arose as a result of market demands and common practices in crustacean fisheries, then no social or cultural impacts to fishing communities will result.

Also, because this measure is not expected to substantially alter current fishing practices, this proposed measure will not have any social impacts on the participants in the directed red crab fishery. This proposed measure is not expected to have any effect on the occupational opportunities of any participants of the directed fishery. The proposed measure is not expected to have any effects on community infrastructure, or the safety of any fishery participants. There appears to be general support for this type of measure among the participants in the directed fishery, and this measure is not expected to decrease the flexibility or stability, or increase the uncertainty, of the participants in the directed fishery.

5.3.2.6 Impacts of the Measure on Protected Species

The proposed option for no regulated minimum allowable size for the red crabs that are retained and landed in the controlled access directed red crab fishery will not change the current trip lengths in the fishery and therefore have no beneficial effect to protected species.

5.3.3 Male Only Fishery

This measure will establish a sex restriction (males only) for all red crabs landed in the controlled access directed red crab fishery.

5.3.3.1 Biological and Ecological Impacts of the Measure on Red Crab

This option would limit the landings of deep-sea red crabs in the directed fishery to males only. The landing of female red crabs would be prohibited, except as an allowance for accidental retention. Many of the points covered in the previous section on "Minimum Size Limit" apply here as well. These two measures are intertwined because males grow larger and weigh more than females. Thus, taking "males only" is equivalent in many respects to taking crabs with a minimum size limit.

The section on minimum size included a table listing the percentage of the total red crab biomass from the 1974 Wigley survey that consists of both sexes as well as males only, for three potential size limits from 4 inches to 4 ½ inches (Table 16). For example, if the Council selects a "male only" fishery with a minimum size of 4 ½ inches, then 47.8% of the total biomass is considered exploitable.

The minimum size section showed that, for a given carapace width, males weigh more than females (Figure 16). Thus, assuming an equal number of crabs were landed, fishing for males-only would increase the short term yield but could decrease the biomass of the stock more rapidly. In addition to these short term effects, there could be more subtle, long term impacts depending on the level of harvests on males and whether or not a size limit was in effect. Harvesting only males could alter the sex ratio and reduce the frequency of large males in the stock. In several species of crabs (blue, stone, and snow) and lobsters, large males are the most successful breeders (Paul and Paul 1996; Jivoff 1997; MacDiarmid and Butler 1999; Sainte-Marie et al. 1999; Kendall et al. 2001). Mating by crabs typically involves courtship, defense and guarding of mates. Sex ratio and size structure of the population can affect mating success and population growth in crabs (see the discussion in the previous section).

5.3.3.2 Ecological Impacts of the Measure on Other Species and Communities

Very little is known about the interactions of the deep-sea red crab with other species and their associated communities. The directed red crab fishery has no known interactions with other species or their associated communities, as the bycatch of other species in the red crab fishery is minimal. The impacts of this fishery on other species or their communities are expected to be minimal to non-existent. This proposed measure would not affect this conclusion.

If new information becomes available that suggests this conclusion may be incorrect, the Council will review the information and consider whether or not additional action may be necessary. Future assessments of this type will consider all new information regarding the interactions of the red crab fishery with other species and their communities and consider mitigation, if necessary, at the appropriate time.

5.3.3.3 Impacts of the Measure to Essential Fish Habitat

Measures that do not directly reduce fishing effort by a gear type associated with adverse impacts to EFH, but rather manage the sex or size class of fish or invertebrates targeted by the industry, such as with the sex restrictions proposed in this measure, would not be expected to have a direct effect on the habitat of the region.

5.3.3.4 Economic Impacts of the Measure on the Fishery

The preferred alternative of this FMP establishes a male only fishery. It may be more difficult to enforce a sex restriction if butchering or processing at sea is allowed. There will be no economic impacts to the harvesting sector due to the male only requirement because it is currently self-regulated to retain and land only male crabs.

There would be no economic impacts to the shore-based processing sector due to the male only requirement, since the sector is currently already self regulated to accept only a certain size of male crab. Because of the difficulty for enforcement posed by the relationship between processing at sea and male only requirements, the processor portion of the catcher/processor vessels may be affected by this measure.

The male only requirement alone would not cause economic impacts to fishery-dependent service industries. The male only requirement used with other measures may cause impacts, but they would be caused by the other measures, and not solely due to this measure. Since the markets tend to enforce male only requirement, there would be no impacts to markets for red crab expected as a result of this proposed measure. There are no known economic impacts to fishing communities expected as a result of this proposed measure, as the measure itself is expected to be self-enforcing.

5.3.3.5 Social/Cultural Impacts of the Measure

There are no data available with which to evaluate the potential impacts of this measure on the social and cultural aspects of New England and Mid-Atlantic fishing communities. The small size, few participants, and distributed nature of this fishery, however, suggests that any social or cultural impacts to these fishing communities will be negligible. For example, there is one red crab vessel based in Gloucester, Massachusetts. Relative to the other fishing activities based in Gloucester, any impacts to this red crab vessel, its owners and operators, crew, fishing-related support services, and their families, that arise as a result of the measures proposed in this FMP are unlikely to significantly affect the community of Gloucester.

Based on information provided by members of the red crab fishing industry in response to a survey collecting baseline information on the fishery, few consider the

communities in which they live to be fishing communities, and fewer still consider their communities to be significantly dependent upon fishing activities (see Appendix B). The implementation of new management programs for the red crab fishery, therefore, would not be expected to significantly disrupt the social frameworks of these communities.

This measure is unlikely to change current fishing practices in the directed red crab fishery. This fishery, although currently not subject to an FMP, already operates by harvesting only male crabs larger than four inches carapace width. Assuming that this measure will not substantially alter that practice, which arose as a result of market demands and common practices in crustacean fisheries, then no social or cultural impacts to fishing communities will result.

Also, because this measure is not expected to substantially alter current fishing practices, this proposed measure will not have any social impacts on the participants in the directed red crab fishery. This proposed measure is not expected to have any effect on the occupational opportunities of any participants of the directed fishery. The proposed measure is not expected to have any effects on community infrastructure, or the safety of any fishery participants. There appears to be general support for this type of measure among the participants in the directed fishery, and this measure is not expected to decrease the flexibility or stability, or increase the uncertainty, of the participants in the directed fishery.

5.3.3.6 Impacts of the Measure on Protected Species

The proposed option for a male-only fishery will have no beneficial effect to protected species. This measure may result in increased trip length (and a decrease in CPUE) if high-grading occurs, meaning that red crab fishing gear would be in the water for a longer period of time, potentially increasing the chances of interactions between the fishing gear used in the red crab fishery and marine mammals or other protected species. However, since this is currently an industry-wide practice, very little increase in trip length is expected.

5.3.4 Butchering/Processing at Sea Restrictions

This measure will place restrictions on the level of butchering and/or processing that may be employed at sea by vessels participating in the directed red crab fishery.

5.3.4.1 Biological and Ecological Impacts of the Measure on Red Crab

If processing at sea were prohibited, this would reduce the maximum number of crabs that could be landed per trip, and this would reduce the risk of overfishing. If processing at sea were allowed, then recovery ratios (the ratio of the weight of the processed product to the weight of whole, unprocessed crab) could be used to make all trips equivalent in terms of number of crab deaths. Recently published (Department of Commerce 2001) recovery ratios for red crab are:

- 25% if the crab is reduced to finished meat product that has been picked, cleaned, and frozen (that is, meat only);

- 58% if the crabs are partially-processed and fully-cleaned (i.e., the gills, mandibles and tail flap are removed), and the meat is not picked;

- 64% if crabs are butchered but not fully-cleaned (i.e., the gills, mandibles and tail flap are still present), and the meat is not picked.

Butchering and partial processing at sea might result increase the number of small crabs (< 4" CW) being retained in the catch. This would be difficult to monitor because butchering and processing break the carapace and crab parts become separated. The long term effect of taking smaller crabs as well as large crabs would be fewer large and old animals in the equilibrium population (Barry and Tegner 1989; Kruse et al. 2000).

Without an overall TAC, as well as trip and trap limits, a simple prohibition on processing at sea may not effectively constrain total harvest.

5.3.4.2 Ecological Impacts of the Measure on Other Species and Communities

Very little is known about the interactions of the deep-sea red crab with other species and their associated communities. The directed red crab fishery has no known interactions with other species or their associated communities, as the bycatch of other species in the red crab fishery is minimal. The impacts of this fishery on other species or their communities are expected to be minimal to non-existent. This proposed measure would not affect this conclusion.

If new information becomes available that suggests this conclusion may be incorrect, the Council will review the information and consider whether or not additional action may be necessary. Future assessments of this type will consider all new information regarding the interactions of the red crab fishery with other species and their communities and consider mitigation, if necessary, at the appropriate time.

5.3.4.3 Impacts of the Measure to Essential Fish Habitat

This measure restricts the amount and type of butchering and/or processing of red crabs at sea by vessels participating in the controlled access red crab fishery. This type of management measure, which controls how the fishermen treat the crabs once they are harvested but does not affect their harvesting techniques, would not have any direct effect on the habitat of the Northeast region. There may be an indirect effect by potentially restricting some vessels from continuing their current practices. If these restrictions reduced the fishing power of these affected vessels (by limiting the amount of red crabs they can harvest before reaching their vessel's capacity), overall fishing effort in the fishery may be reduced. However, because the directed red crab fishery is not believed to be associated with any adverse impacts to the EFH of any managed species, any indirect reduction of fishing effort would not have an impact on the habitat of the region.

5.3.4.4 Economic Impacts of the Measure on the Fishery

The FMP will establish processing-at-sea restrictions for the controlled access directed red crab fishery. Butchering and/or processing red crabs at sea (versus landing

crabs whole) expands the vessels' capacity to harvest red crab on a per trip basis. The FMP includes several options to set restrictions and/or prohibitions on the butchering and/or processing at sea of red crabs. These types of measures will be balanced against the other potential measures included in the FMP, such as minimum size limits and sex restrictions. The more butchering and processing activities that are allowed under the FMP, the more difficult it will be to control as well as enforce the number of small crabs being landed.

A prohibition on processing or butchering at sea would reduce the maximum number of crabs that could be landed per trip for those vessels which do not currently land live crabs, depending on the vessels' hold capacity. Existing vessels that butcher and/or process at sea (within reasonable limits) may be given an exemption to this option -- in order to allow them to continue to fish for red crab in the method for which their vessel is best suited. Existing vessels that do not butcher and/or process at sea would not be allowed to convert, and any new vessels entering the fishery (if allowed) would have to land their crabs whole. If existing vessels were granted the exemption, those that currently process on board may be seen to have an advantage over those that do not. They, in fact, would be able to continue to fish in the manner that was most efficient for them in the past. This would be closely tied to the option of limited access and what vessels are allowed to fish, and especially under any possible exemption of restrictions.

The preferred option will allow all activities except the removal of meat from the body and/or legs of the crab. Any activity short of removing the meat (including splitting, sectioning, freezing, cooking, and/or glazing of crab sections) will be allowed under this option. At the other end of the spectrum, one of the non-preferred options would allow all processing and butchering activities. Under this option, vessels could separate meat from the crab body and clean, cook, glaze, and/or freeze, etc. at sea with no restrictions. If centrifuge or other meat separation technology were to be used on board a red crab fishing vessel in the future, it would become impossible to control the size of crabs harvested, processed and landed.

Appropriate recovery rates will be used for all contingencies to accurately determine the whole weight equivalent from the weight of the butchered crabs. The recovery rates used will be dependent upon the specific process used (e.g., crabs simply split with the carapace removed would be converted differently than sections glazed and frozen).

As a stand-alone measure, a simple prohibition on processing at sea would not control effort in the fishery sufficiently to constrain total harvest. Only one of the historical participants processes at sea, which butchers its crabs (as opposed to full processing). New entrants to the fishery are capable of processing red crab at sea. Prohibiting all forms of processing at sea would greatly reduce a vessels ability to increase its fishing capacity because the effective capacity would be constrained by the vessels ability to maintain its crabs alive, as well as by its hold capacity. If processing at sea is allowed, in the absence of other measures, a catcher-processor vessel that has a large hold capacity for processed product would likely harvest more than the traditional vessels on any one trip. The hold capacity of red crab vessels is variable, ranging from

60,000 pounds to approximately 320,000 pounds, and averaging just over 122,000 pounds whole weight equivalent.

A prohibition on all forms of processing at sea would prevent some vessels from operating as they currently are designed to do, as well as curtailing these same vessels from supplying the processed product market that has been established. While some controls are needed to prevent overfishing, this can be accomplished through a combination of other measures (e.g., TAC, DAS) that allow more flexibility as to which vessels can fish and what product these vessels choose to land.

Under some options considered by the Council, a vessel that is currently processing at sea may be prohibited from doing so, and may potentially no longer be profitable and may cease fishing. The potential capacity and fishing patterns of those vessels capable of processing at sea is not clear at this time, given the short time frame some vessels have reportedly been in the fishery. However, the capacity of any vessel that processes at sea is greater than one that does not, everything else being equal. Not allowing processing at sea would certainly be dissuasive to the freezer/processor vessel owners, given the presumably higher fixed and variable costs associated with operation of larger vessels, processing facilities and the employment of additional crew.

The preferred alternative (to allow butchering and partial processing of red crabs at sea) will minimize the enforcement costs and difficulty while allowing vessels to continue to operate in a manner that is most familiar and efficient for them. It will provide for minimum disruption (and costs) to those now in the fishery. To date, no crab vessel has removed meat from the crab, so a prohibition on this type of processing will have minimal economic impact on the fishery.

The degree of processing allowed and the corresponding definitions accepted will influence the degree of impact on the red crab vessels, and especially on the processing sector. Processing on board restrictions would appear to have minimal impact on most of the vessels that have been in the fishery prior to 2000. There is one vessel that has fished before the control date that would be impacted, and others that have fished after the control date. A complete prohibition on processing at sea may have disproportionate effects by vessel size class with the largest vessels the most negatively impacted.

Since processing at sea is more labor-intensive than landing live crab, there would be some employment effects to such a prohibition. Any vessel that does complete processing at sea and that has a corresponding larger crew would be the most affected. Other vessels that do partial processing would be affected by the prohibition, as well. On the other hand, if live whole crabs were landed, the processing would still be done somewhere, whether it is in one of the ports in which it is landed or exported to Canada.

There is very little information available directly on any fishery-dependent service industries that may be influenced by changes in the processing at sea practices in the red crab fishery. The type of service industries used by the red crab fishery and their general locations was reported by some vessel owners and operators in the survey given to red crab advisors. The types of services used include: fuel, ice, food and groceries, bait, gear,

oil/lubrication, water, hull maintenance, engine maintenance, electronics, insurance, accounting, legal advice, and dockage. These needs are met by services provided in Lower Mid-Coast Maine, Gloucester and the Massachusetts North Shore, Boston and the Massachusetts South Shore, Cape Cod and the Islands, the New Bedford, MA area, Rhode Island, some non-coastal areas of New England, and some areas outside of New England. Of these, the fishery-related service industries in the New Bedford, MA area provide more support to the red crab fishery than the other locations combined. Due to the small size of the fishery, and the small number of fishing vessels involved, however, it is unlikely that providing these services to red crab vessels accounts for more than a very minor component of any service industry's overall fishery-related revenue.

There may be implications to the markets for red crab expected as a result of processing at sea restrictions. Depending on what level of processing is allowed, certain vessels may not be operating in the future which could affect the product supply, or the product mixes that are available to the wholesaling and retailing sector. Since one intent of the FMP is to limit the supply of red crab to an optimal level, there may be slightly less red crab provided to the markets.

There are no known economic impacts to fishing communities expected as a result of this proposed measure. There are no communities dependent upon the directed red crab fishery. Since the size of the fishery is so small, and so few vessels participate, the impact of any change in the red crab fishery is overwhelmed by the influence of larger fisheries, which generate greater revenue.

5.3.4.5 Social/Cultural Impacts of the Measure

There are no data available with which to evaluate the potential impacts of this measure on the social and cultural aspects of New England and Mid-Atlantic fishing communities. The small size, few participants, and distributed nature of this fishery, however, suggests that any social or cultural impacts to these fishing communities will be negligible. Based on information provided by members of the red crab fishing industry in response to a survey collecting baseline information on the fishery, few consider the communities in which they live to be fishing communities, and fewer still consider their communities to be significantly dependent upon fishing activities (see Appendix B). The implementation of new management programs for the red crab fishery, therefore, would not be expected to significantly disrupt the social frameworks of these communities.

The different options considered for this measure are associated with different levels of impacts to the fishermen currently involved in the directed red crab fishery. The most restrictive option would require that all crabs harvested in the directed red crab fishery be landed whole. The majority of vessels currently involved in the directed red crab fishery maintain the crabs whole and alive in refrigerated sea water (RSW) tanks and these participants would not be affected by any of the options under consideration. One traditional participant and at least one new entrant in the directed fishery employ some form of butchering on-board their vessels while at sea. These participants may be affected by some of the options under consideration.

If the most restrictive option is selected, these participants would be forced to either alter their current fishing practices to comply with the new regulations or, if they are unable to adapt, leave the fishery. If they leave the fishery, this could have an effect on their occupational opportunities if they are unable to find employment elsewhere. Leaving the fishery would also decrease their flexibility and the stability they have in the fishery, increasing the uncertainty they feel about their future in the fishing industry.

If they can remain in the red crab fishery, but must alter their fishing practices, this could also affect the occupational opportunities of these participants if the vessels would use fewer crew under the new regulations. Changing their vessel's fishing practices could have an effect on safety if any aspect of their new fishing practices increases the likelihood of injury or other incident. This adaptation to the new regulation, while not as severe as being forced to leave the fishery, would nonetheless decrease their flexibility and stability and increase their level of uncertainty for the future. The more restrictive options under this measure are not supported by the current participants of the directed red crab fishery.

The preferred option, prohibiting the full processing of red crabs at sea (removing the meat from the shell) but allowing butchering of crabs at sea, is supported by the current participants of the fishery and would not be expected to have any adverse social impacts on these participants. No current participant in the directed red crab fishery is known to fully process red crabs on board their vessel while at sea. Adoption of this option, as opposed to the least restrictive option -- no restrictions on butchering or processing at sea -- would be expected to have beneficial social impacts for the participants as they have voiced support for this measure and it would provide them an increased sense of stability in the fishery. These members of the industry have indicated concern over the potential for vessels to fully process red crabs at sea and the potential impacts that would occur to the resource. Thus, not restricting processing at sea could actually increase the level of uncertainty in the fishery and have greater adverse social impacts than a more restrictive option.

5.3.4.6 Impacts of the Measure on Protected Species

The prohibition on full processing of red crab at sea will have no effect (beneficial or adverse) to protected species as it does not modify active fishing operations such as deployment or retrieval of gear or the physical characteristics of the gear used. Partial processing and butchering at sea may extend trip lengths, but is not expected to increase the total amount of fixed gear that may be set in the red crab fishing areas.

5.3.5 Trap/Pot Limits

This measure will establish trap/pot limits for the controlled access directed red crab fishery, capping the maximum number of traps that may be used.

5.3.5.1 Biological and Ecological Impacts of the Measure on Red Crab

Capping the number of pots per vessel, the number of pots per string and the number of strings per vessel would cause vessels in the fleet to have similar efficiencies.

Currently, vessels are reportedly fishing with 500-600 pots. Without considering the entire fishing process, it is unclear what specific effect capping the number of pots would have on the red crab stock. The catch from a trip is determined not only by the total number of pots being fished, but by the number of pots per string (trawl), the number of trawls, the number of times each trawl is set and hauled during a trip, the time required to set and haul a trawl, and whether the vessel lands live, sectioned, or totally processed crab product. For example, without a trip limit or a rule limiting processing at sea, then catcher-processing vessels could continually reset their traps, process the resource on-board, and quit only when their vessel's hold capacity was reached. To better enforce a trap limit, some form of trap tag or buoy marking system should be employed.

5.3.5.2 Ecological Impacts of the Measure on Other Species and Communities

Very little is known about the interactions of the deep-sea red crab with other species and their associated communities. The directed red crab fishery has no known interactions with other species or their associated communities, as the bycatch of other species in the red crab fishery is minimal. The impacts of this fishery on other species or their communities are expected to be minimal to non-existent. This proposed measure would not affect this conclusion.

If new information becomes available that suggests this conclusion may be incorrect, the Council will review the information and consider whether or not additional action may be necessary. Future assessments of this type will consider all new information regarding the interactions of the red crab fishery with other species and their communities and consider mitigation, if necessary, at the appropriate time.

5.3.5.3 Impacts of the Measure to Essential Fish Habitat

Although crab traps are not considered to contribute any adverse impacts to the types of habitat found within the area of the directed red crab fishery (based on the results of studies on the effects of lobster and crab traps on a variety of habitat types by Eno et al. 1999), the limited available information suggests that if there were any impacts associated with this fishery, limiting the number of traps used in the fishery, and thus in contact with the bottom, may serve to reduce any potential risk.

Current reports from the fishing industry suggests that the industry average number of traps employed by each vessel is 560. Only the proposed limit of 400 traps per vessel would result in an overall reduction in traps being used in the fishery. The other two options (the preferred option of 600 and the option for1000 traps allowed per vessel) would not result in any reduction of the number of traps used in the fishery.

If no reduction in the overall number of traps used in the fishery results from this measure, then there would be no potential immediate benefits to any habitat within the range of the red crab fishery that may be impacted by this gear. If the trap limit of 400 traps per vessel is selected and the overall number of traps employed in this fishery is decreased, then there may be a benefit to habitat implied by this reduction of gear in contact with the bottom.

It should be clearly recognized, however, that there is no information available to the Council that suggests the amount of fishing gear used in the red crab fishery should in any way be restricted in order to protect the EFH of any managed species.

5.3.5.4 Economic Impacts of the Measure on the Fishery

The FMP will establish gear or trap limits for the directed red crab fishery. This measure will limit the number of pots that a vessel could fish on a per trip basis, and will serve to control the effort of the fishery in conjunction with a trip limit. It is unclear what effect, if any, capping the number of pots alone would have on the fishery, or if it would be redundant with the use of trip limits. Vessels fishing primarily for lobsters may employ more traps than the trap limits specified, but these vessels would only be subject to the red crab incidental catch limit, not the trap limit. The administration and enforcement of this potential measure may be complicated by the proximity of the offshore lobster fishery and red crab vessels that are permitted to also fish for lobsters. As a partial solution to improve the enforceability of this measure, rather than manage the trap limit by counting individual traps, the preferred alternative will implement a maximum traps per string equivalent rule.

Capping the number of pots per vessel, the number of pots per string and the number of strings per vessel would force vessels in the fleet to behave similarly. However, larger vessels may be forced to operate in a less efficient manner due to constraints equally imposed. Without considering the entire fishing process, it is unclear what specific effect capping the number of pots would have on the red crab fishery. The catch from a trip is determined not only by the total number of pots being fished, but by the number of pots per line (trawl), the number of trawls, the number of times each trawl is set and hauled during a trip, the time required to set and haul a trawl, and whether the vessel lands live, sectioned, or totally processed crab product. If there is not a corresponding trip limit or a rule limiting processing at sea, catcher-processing vessels could continually reset their traps, process the resource on-board, and quit only when their vessels hold capacity was reached. To better enforce a trap limit, a trap tag or buoy marking system should be employed.

If the non-preferred option of 400 traps per vessel were chosen, this would severely limit all red crab directed vessels. The preferred alternative, 600 traps per vessel, has been reported as the "industry standard" used by most vessels, although individual vessels may vary slightly from this number. This limit would prevent any vessel from increasing the number of traps it actively fishes, either in an attempt at increasing their effort or in an attempt at "holding bottom." A trap limit of 600 pots would have minimal effect on the fishery as currently prosecuted. The vessels operating as of the control date all report fishing between 500 and 600 pots, and at least one of the new entrants is reportedly fishing 600 pots. A 600-pot limit may not be a reduction for any vessels currently fishing red crab, and is consistent with the NMFS emergency regulations.

The most common method of red crab fishing is to set traps or pots for a short time (< 24 hours), haul and then reset all traps, repeating this process until the vessel's hold is full or it becomes uneconomical to remain on the fishing grounds (e.g., because catch

rates are declining or mortality and/or product quality of the crabs on board is declining). Traditionally, most of the vessels in the fishery make eight to ten day trips where seven to eight days are spent on the fishing grounds. They haul, on average, 500-600 traps per day, working about sixteen hours, although new entrants may be able to haul significantly more traps per day, especially if they work 24 hours a day due to larger crew size.

With a very low trap limit (e.g., 100 - 200 traps per vessel), each vessel would likely be restricted to fishing only six to eight hours per day, and, in order to reach their hold capacity, vessels would have to extend the length of their fishing trips. This would diminish the profitability of each trip, as fuel and food costs increase in proportion to trip revenue. With a higher trip limit or no trip limit, the larger vessels could potentially land significantly more trips, thereby creating a derby-type fishery. Also, for the vessels that land live crabs, increasing the length of the trips would increase the proportion of crabs that die before being landed. Reportedly, with any trip over eight days, increasing percentages of "dead loss" occur. The vessels that butcher/partially process and freeze the resulting product would not be affected in this way, so they could continue fishing without concern over dead loss.

The processing sector (shore-based) is dependent upon a steady supply of red crab product from the vessels. Any change in the number of pots which has an effect on the amount of red crab product landed will in turn have an effect on those that process it. There are no economic impacts to fishery-dependent service industries expected as a result of proposed gear or trap limits. Any change in the number of pots which has an effect on the amount of red crab product landed will in turn have an effect on the markets. Any change in the amount of product landed as a result of gear limits will be quite small.

There are no economic impacts to fishing communities expected as a result of this proposed measure. Since the size of the fishery is so small, and so few vessels participate, the impact on any change in the red crab fishery is overwhelmed by the influence of larger fisheries that generate greater revenue.

5.3.5.5 Social/Cultural Impacts of the Measure

There are no data available with which to evaluate the potential impacts of this measure on the social and cultural aspects of New England and Mid-Atlantic fishing communities. The small size, few participants, and distributed nature of this fishery, however, suggests that any social or cultural impacts to these fishing communities will be negligible. Based on information provided by members of the red crab fishing industry in response to a survey collecting baseline information on the fishery, few consider the communities in which they live to be fishing communities, and fewer still consider their communities to be significantly dependent upon fishing activities (see Appendix B). The implementation of new management programs for the red crab fishery, therefore, would not be expected to significantly disrupt the social frameworks of these communities.

Two of the three options under consideration, including the preferred option, for this measure would not affect the fishing practices of any current participants in the directed red crab fishery. The current fleet average number of pots used per vessel is 560

and no vessel reports using more than 600 pots. The options to set a pot limit of 600 or 1000 pots per vessel would have no impacts, social or otherwise, on the current practices of the fishery. The third option, to set a pot limit of 400 pots per vessel, may have an effect on any participants who currently use more than 400 pots.

The effects of this new limit could result in vessels remaining at sea for longer periods of time (assuming they do not change their average soak time and remain at sea long enough to obtain the same amount of landings as they previously had). Remaining at sea for longer periods of time could cause adverse social impacts reflected in additional time away from home and their families, and increase safety risks associated with longer fishing trips. This option could also decrease the flexibility of many participants in the fishery and increase uncertainty on several fronts. While there is general support in the industry for a trap limit of 600 pots per vessel, there would not be support for a measure that limited gear to 400 pots per vessel.

5.3.5.6 Impacts of the Measure on Protected Species

Reduced fishing effort may be seen as having a direct beneficial effect on marine mammals and other protected species if the average trap trawl length remains the same. The current average trap usage by vessel is 560. The proposed limit of 600 traps represents no real change from present practice. This measure will prevent any expansion of trap trawl length in the future. For marine mammals and other protected species, a beneficial impact could be expected at 400, no change at 600, and an adverse impact at 1000 (assuming that the fishing vessels actually increased their trap usage up to the limit[15]). The current fleet practice of leaving the gear at sea between fishing trips has a potential adverse impact for protected species, although the Atlantic Large Whale Take Reduction Plan (ALWTRP) prohibits this practice as "wet storage" if it occurs for more than 30 days.

5.3.6 Gear Requirements/Restrictions

The preferred options for this measure propose to implement several types of restrictions and limits on the type, size and design of fishing gear used in the directed red crab fishery, including prohibiting all fishing gear types except crab pots in the directed red crab fishery. This proposed measure is different from the others considered in this FMP in that the specific options are really sub-measures that are not mutually exclusive. Unlike measures such as the incidental catch limit, where the options are mutually exclusive variations that specify the particular catch limit to be implemented in the FMP, this measure is really a catch-all for gear-type regulations considered under this FMP. All of the following options could be implemented for this fishery, or none could be implemented. Also, there are no specific variations identified for most of these options.

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[15] It should not be a foregone conclusion that the red crab vessels would increase their trap usage up to the level of the new maximum, should the Council select a 1000 trap per vessel limit. Prior to the emergency regulations, the red crab fishery was unregulated and yet the fishery naturally settled on an industry average of less than 600 traps per vessel. This level of trap usage is most likely the most efficient for this fishery and is unlikely to change significantly unless *reduced* by regulation.

For example, there are no specific sizes proposed for the escape vent option, although if the escape vent was selected, a particular size would have to be determined.

5.3.6.1 Biological and Ecological Impacts of the Measure on Red Crab

The biological and ecological impacts of the options proposed in this measure vary according to each option (these options are not variations on a theme, but are actually distinct options which are not mutually exclusive) and will be assessed separately.

Escape Vents

This non-preferred option proposed requiring escape vents on all traps used in the directed red crab fishery to ensure the adequate escapement of undersized crabs. This type of option has obvious benefits to the resource by reducing the potential for discard mortality of females and juvenile males that are brought to the surface in the traps, sorted, and then released back into the water. While the actual discard mortality is unknown, it is assumed that at least some of these crabs suffer mortality as a result.

Unfortunately, although this option would have benefits to the red crab resource, no selectivity studies have been done to determine the appropriate size escape vents needed in this fishery. If the required escape vents were too small, then undersized crabs would be retained and much of the anticipated benefits would be lost. If the required escape vent was too big, then market-sized crabs would also escape and the yield of the fishery would decline.

It would be impossible, with the available information, to suggest a biologically-based escape vent size. This may not be immediately necessary, as fishermen have reported that a mechanism already exists for the escapement of undersized crabs. The trap design most commonly used in the directed red crab fishery is a rectangular wood and wire trap, and the wood lathes are spaced approximately two inches apart. The fishermen report that this lathe spacing allows small crabs to escape.

Given the paucity of scientific information on this issue on which to base a management decision, the FMP is intended to encourage the fishermen to continue their current practices and to continue to use a gear design that allows some degree of escapement. Meanwhile, the FMP will request that NMFS, or another appropriate scientific group (possibly working in conjunction with the fishing industry), conduct selectivity studies on a variety of escape vent sizes (see Section 9.0). Upon completion of these studies and the data being made available, the Council would be able to consider whether additional action is necessary to require a minimum escape vent size and would have the information with which to determine the appropriate size for the escape vent.

Trap Size

In theory, larger traps can result in higher catches. This assumes, however, that all other variables remain the same: number of traps, number of trap hauls, soak time between hauls, number of traps per string, etc. The principal potential impact on the resource from an increase in trap size above what is currently being used would be

increased catch rates. Increased catch *rates* are not necessarily a problem if the overall catch does not change (e.g., whether a vessel takes 50,000 pounds of crab on a trip hauling 3,000 traps of the current size or 2,000 larger traps is of little overall consequence to the resource).

Thus, assuming that the FMP will implement some form of overall catch controls on the directed red crab fishery (hard TAC, IVQ, trip limits with a set number of trips, etc.), establishing a maximum trap size will not have a biological impact. If, however, effort is controlled in such a way that catch rates per unit of effort could vary, then a trap size restriction would have an important role in providing protection for the resource. For example, if the measure to implement a DAS program is the primary effort control mechanism selected for this fishery, so it will be very important to understand the relative fishing power of each individual DAS. Given a constant allocation of days, increasing trap size (and thus increasing the catch rates per trap haul) could be one mechanism used by the industry to increase the efficiency of their allocated DAS.

In order to effectively manage the fishery using this type of effort control and not have unintended negative consequences on the resource, a maximum trap size is being proposed for the directed red crab fishery. Without a maximum trap size, increased catch rates per DAS could result in overexploitation of the resource.

Trap Materials

This non-preferred option would be unlikely to result in any direct impacts to the resource. The option was primarily intended to offer the Council a mechanism to "freeze" trap design so that different trap technologies cannot be used to alter the efficiencies of the traps. It is impossible at this time, however, to speculate on what those trap technologies might be and what their effects would be on trap efficiency.

Gear Markings

This preferred option is purely administrative in nature, intended to aid in the identification of fishing gear being used in the directed red crab fishery and to aid in the enforcement of management measures implemented via this FMP, and will have no biological or ecological impacts on the resource.

Trap Configuration and Deployment

This non-preferred option would be purely administrative in nature, intended to aid in the enforcement of any trap limits implemented via this FMP, and would have no biological or ecological impacts on the resource.

Ghost Panel

It is common for fishermen, especially trap fishermen, to lose some amount of their fishing gear throughout the year. Members of the red crab industry have reported losing an average of 10.5 traps per fishing trip. Fishing gear that is lost and remains on the bottom often continues to function for some time to come. This is called "ghost fishing"

and is believed to have potentially significant impacts on resources trapped in the "ghost gear." The management of trap fisheries often require the installation of a biodegradable panel in the trap of such a size that should the gear become lost to the fisherman and the panel opens, all animals trapped in the gear would be able to escape.

This has obvious potential benefits to the resource, as individuals that remain trapped in ghost gear will die and cannot contribute either to the fishery or to the reproductive potential of the resource. Implementation of this option would require that all participants in the directed red crab fishery either install some type of biodegradable panel or element to their trap gear to allow for the escapement of all animals should the gear remain on the bottom for a significant period of time, or that the trap design itself be constructed of biodegradable materials. The most common trap design currently used in the fishery consists of a wood, wire, and twine gear that should be sufficiently biodegradable to meet the objectives of this option. Fishermen using any other gear type that is not biodegradable should be required to install some type of ghost panel in order to minimize the potential for unintended ghost fishing mortality on the resource.

Marine Mammal Requirements

This option is intended solely to meet the requirements of the Atlantic Large Whale Take Reduction Plan (ALWTRP) and will have no affects on the resource.

Prohibition on the Use of Parlor Traps

This preferred option will prohibit the use of parlor traps in the controlled access directed red crab fishery. Parlor traps improve the ability of traps to retain crabs over a longer time. Thus the use of parlor traps could increase fishing effort, particularly if accompanied by a change in fishing strategy, such as longer soak times. Parlor traps would likely increase the productivity of traps when they are left on the fishing grounds between trips. Because the current traps do not prevent the escape of crabs from the trap, many of the crabs that might enter the traps during the period between trips are gone before the vessel returns to haul the traps on the next trip. Parlor traps would increase the concern about "ghost" fishing if traps are lost. Lost traps do not present a ghost fishing problem at present because the crabs can escape from the traps. Parlor traps would be more likely to cause handling damage to crabs, lower product quality for the marketable crabs that were kept, and increase mortality for the crabs that are released alive.

Prohibition on the Use of Other Gear Types

This preferred option will require that all participants in the directed red crab fishery employ trap gear only in this fishery. The use of trawls, dredges, nets, or other types of fishing gear will be prohibited in the directed fishery. The effect of this measure on the resource will be primarily determined by the reduction in any potential discard mortality associated with non-trap gear, especially in the bottom-tending mobile gears such as trawls and dredges. All current participants in the directed fishery use traps as their sole gear type, so implementation of this option will not have a direct affect on the resource except as a mechanism to prevent a future *increase* in discard mortality

associated with the directed fishery should a participant desire to change their gear type.

5.3.6.2 Ecological Impacts of the Measure on Other Species and Communities

Very little is known about the interactions of the deep-sea red crab with other species and their associated communities. The directed red crab fishery has no known interactions with other species or their associated communities, as the bycatch of other species in the red crab fishery is minimal. The impacts of this fishery on other species or their communities are expected to be minimal to non-existent. This proposed measure would not affect this conclusion.

The trap-only restriction proposed in this measure would prevent an increase in adverse impacts to other species and their associated communities that would result from an increase in dragging for red crabs. If new information becomes available that suggests this conclusion may be incorrect, the Council will consider whether or not additional action may be necessary. Future assessments of this type will consider all new information regarding the interactions of the red crab fishery with other species and their communities and consider mitigation, if necessary, at the appropriate time.

5.3.6.3 Impacts of the Measure to Essential Fish Habitat

The majority of options proposed in this measure affect only the design and size of the fishing gear to be used in the directed red crab fishery. Options such as escape vents, ghost panels, trap tags and gear markings, and marine mammal requirements would not have any direct or indirect effect on the habitat of the region.

The option to restrict the size of the traps used in the directed red crab fishery could have an effect on habitat if the option reduced the overall size (particularly the footprint) of the gear; however, this option only proposes to establish limits that would maintain the current size of the gear and prevent any increase in the size of the gear. This could have an indirect effect on the habitat of the region by preventing the development or use of much larger and/or heavier trap gear in the future (such as the 7' by 7' steel traps commonly used in the West coast crab fisheries). Larger and/or heavier trap gear may have more of an impact on the habitat of the region than the currently used gear is believed to have.

The option to control the materials allowable in the construction of the traps used in the directed red crab fishery could have an effect on the habitat of the region if this option prevented the use of toxic materials in the traps that could have an adverse impact on habitat. The materials currently used in the construction of the traps used in this fishery are not known to be or to contain any toxic materials, therefore this option would not provide any immediate benefits to habitat.

The most significant option within this measure that could contribute to the protection of EFH is the option to prohibit the use of all gears types except traps in the directed red crab fishery. Although this fishery is currently trap-only and there would be no immediate benefits to habitat associated with this option, without this option the participants of the fishery could switch to other gear types, such as otter trawls and

dredges, that are often associated with adverse impacts to certain types of habitat. This option will prevent this from occurring, thus ensuring a continued trap-only fishery and minimal, if any, impacts to habitat.

5.3.6.4 Economic Impacts of the Measure on the Fishery

The FMP will establish some form of gear requirements and/or restrictions for the directed red crab fishery. The Council considered the need/utility for requiring escape vents (of a size to be determined to allow for the escapement of small crabs and possibly females), size and material restrictions, gear marking or trap tag requirements on all traps used in the directed red crab fishery. Depending on the modifications that are necessary to the traps or other gear used in the directed red crab fishery, the costs of those changes must be taken into account. The preferred alternative does not have a requirement for an escape vent, so there will be no additional costs for that modification.

The preferred alternative requires gear markings on all buoys used at the end of each red crab trap trawl. Under the preferred alternative, gear types other than red crab traps, such as otter trawls, dredges, nets, etc., will be prohibited from use in the directed red crab fishery. This prohibition would not apply to those vessels retaining incidental catch-level amounts of red crab harvested while participating in other fisheries. Vessels holding an open access red crab incidental catch permit may use any type of fishing gear they choose. Public opinion was expressed by otter trawl owners who are concerned about the level of incidental catch that would be allowed under the preferred alternative for non-trap gear types.

In calendar year 2000, according to NMFS dealer data, there were three vessels who reportedly used a gear other than crab pots to land red crab, but those other gears were either offshore lobster pots or a unknown type of pot or trap. This may indicate that this gear restriction may have some adverse impacts on these three vessels (by encouraging them to switch gears to red crab traps only) or it may simply be an anomaly in the recording system. In calendar year 2001, NMFS dealer data indicates additional non crab-pot effort, reporting seven vessels using other than crab pots/traps. Four of these were otter trawlers.

In the VTR data in 2000, there were two otter trawlers and five types of lobster pot gear identified. In 2000, there was only one vessel that reported using crab pots, another reminder of the poor data. In the VTR data in 2001 (as of 2/15/2002), there were three otter trawlers, four vessels using lobster pots, and three red crab vessels. Even though 2001 data are not complete, there is a trend for additional vessels and dealers to report their red crab landings. Because of the emergency action and its requirement to report landings and effort, we are collecting more data than in the past. We know from the survey that most respondents (all in the directed fishery) report 100% dependence on the red crab fishery for their annual income.

Gear requirements would be primarily non-controversial modifications that would be good for the red crab resource and would not reduce the amount of the resource available to be processed. Thus, this would not have an impact on the processing

component of the red crab fishery.

There are no economic impacts to fishery-dependent service industries expected as a result of proposed gear restrictions. The types of services used include: fuel, ice, food and groceries, bait, gear, oil/lubrication, water, hull maintenance, engine maintenance, electronics, insurance, accounting, legal advice, and dockage. The current suppliers of these types of services would easily handle any modifications needed to the gear. Given the small number of fishing vessels involved, it is unlikely that providing a change in services to red crab vessels would account for much of a change to any service industry's fishery-related revenue.

Any change in gear restrictions which has an effect on the amount of red crab product landed, will in turn have an effect on the markets. In this case, the amount of red crab landed will not be changed significantly by the gear requirements considered here. Any change in the amount of product landed as a result of gear restrictions will be quite small. There are no economic impacts to fishing communities expected as a result of this proposed measure. Since the size of the fishery is so small, and so few vessels participate, the impact of any change in the red crab fishery is overwhelmed by the influence of larger fisheries, which generate greater revenue.

5.3.6.5 Social/Cultural Impacts of the Measure

There are no data available with which to evaluate the potential impacts of this measure on the social and cultural aspects of New England and Mid-Atlantic fishing communities. The small size, few participants, and distributed nature of this fishery, however, suggests that any social or cultural impacts to these fishing communities will be negligible. Based on information provided by members of the red crab fishing industry in response to a survey collecting baseline information on the fishery, few consider the communities in which they live to be fishing communities, and fewer still consider their communities to be significantly dependent upon fishing activities (see Appendix B). The implementation of new management programs for the red crab fishery, therefore, would not be expected to significantly disrupt the social frameworks of these communities.

Most of the options considered under this measure are largely administrative in nature and would not substantively change current fishing practices. Options such as those requiring escape vents, limiting trap construction materials, trap tags and gear marking requirements, ghost panels, and even the marine mammal requirements, would not be expected to cause any social impacts to the participants of the fishery. The only potential social impact associated with these options may be an increase in the stress levels of vessel owners and operators if they are concerned about their ability to comply with any new gear-related requirements.

Because these options are not expected to substantially alter current fishing practices, these aspects of this proposed measure will not have any social impacts on the participants in the directed red crab fishery. This proposed measure is not expected to have any effect on the occupational opportunities of any participants of the directed fishery. The proposed measure is not expected to have any effects on community