3.0 Fishery Management Program

3.1 Management Goals and Objectives

The management goals and objectives for the Red Crab FMP are described below.

Goal 1: Consistent with the National Standards and other required provisions of the Magnuson-Stevens Fishery Conservation and Management Act, manage the Atlantic deep-sea red crab fishery at sustainable levels.

Goal 2: Create a management system so that fleet capacity will be commensurate with resource status so as to achieve the dual goals of economic efficiency and biological conservation.

Goal 3: Maintain a directed fishery for Atlantic deep-sea red crab, while at the same time allowing all fishermen the continued opportunity to land appropriate amounts of red crab as bycatch.

Goal 4: Minimize, to the extent practicable, adverse impacts on fishing communities during the transition from an unregulated fishery to a regulated one.

Objective 1: Achieve, on a continuing basis, optimum yield (OY) for the U.S. fishing industry.

Objective 2: Prevent overfishing of the red crab resource.

Objective 3: Develop a definition of overfishing.

Objective 4: Develop biological, economic and social measures of success for the red crab fishery and resource.

Objective 5: Develop a controlled access system to keep fishing capacity matched to the available resource.

Objective 6: Adopt fishery management measures that constrain fishing mortality to levels that are compliant with the Sustainable Fisheries Act.

Objective 7: Promote research and improve the collection of information to better understand red crab population dynamics, biology and ecology, and to improve assessment procedures in cooperation with the industry.

Objective 8: Minimize, to the extent practicable, adverse impacts associated with management of the red crab fishery on other fisheries.

Objective 9: To the maximum extent possible, maintain a twelve month fishery.

3.2 Management Unit

The choice of a management unit depends on the focus of the FMPs objectives, and may be organized around geographic, economic, technical, social, or ecological perspectives. The management unit includes the species of concern, the identification of distinct stocks, if any, and the geographic area subject to management. Although this species has a wide range (published ranges for this species have varied from Nova Scotia to Cuba and also to Brazil) and it also occurs in the Gulf of Mexico, the area of primary concern for the Council most likely ranges from about Norfolk Canyon in the south to the Hague Line in the north. The Council considered information on the geographic range of the species and any known stock structure, as well as the desired regulatory area, and establish geographic limits on the management unit for this FMP. It is considered a rebuttable presumption that any red crab on-board or off-loaded from a vessel in the northwest Atlantic was harvested from the New England / Mid-Atlantic EEZ and therefore subject to the regulations of this FMP.

Historically, most commercial fishing for red crab has occurred off Southern New England (Lux et al. 1982; Elner 1986), but commercial fishing operations are also known to target the southern flank of Georges Bank and the Mid-Atlantic as far south as Cape Hatteras, North Carolina. Typically, an FMP manages the fishery for each species included in the management unit throughout the entire range of the species. Red crabs, however, occur off the coast of the south Atlantic states, including Florida, occur in the Gulf of Mexico, and may range as far south as Argentina (Elner 1986). It would not be practical nor prudent for the New England Council to attempt to manage this resource in the Gulf of Mexico or even as far south as Florida. Thus, the management unit will not be defined by the stock boundaries. Instead, the Council identified a geographic point at which our jurisdiction over the management of the resource will end.

There were several alternatives available to the Council for establishing the management unit for this FMP. The alternatives reflected various southern boundaries for the management jurisdiction of the red crab fishery. Potential alternatives included the southern extent of the Wigley et al. (1975) survey that developed a biomass estimate for the stock (Survey Boundary), Norfolk Canyon (unofficially considered the southern extent of the directed fishery), the Virginia/North Carolina border (the northern extent of the South Atlantic Golden Crab FMP management jurisdiction), and Cape Hatteras, North Carolina (consistent with the Emergency Regulations).

3.2.1 Preferred Alternative: Cape Hatteras, NC

The Council has identified a management unit for this FMP. The only species included in the management unit for the Red Crab FMP will be the deep-sea red crab (*Chaceon quinquedens*). Although the range of this species includes the South Atlantic and the Gulf of Mexico, the boundaries of the management unit, also called the management area, will be limited to the waters north of 35º 15.3' north latitude (the latitude of Cape Hatteras Light, North Carolina), bounded by the coastline of the continental United States in the west and north and the Hague Line and seaward extent of the U.S. exclusive economic zone (EEZ) in the east (see Figure 1).

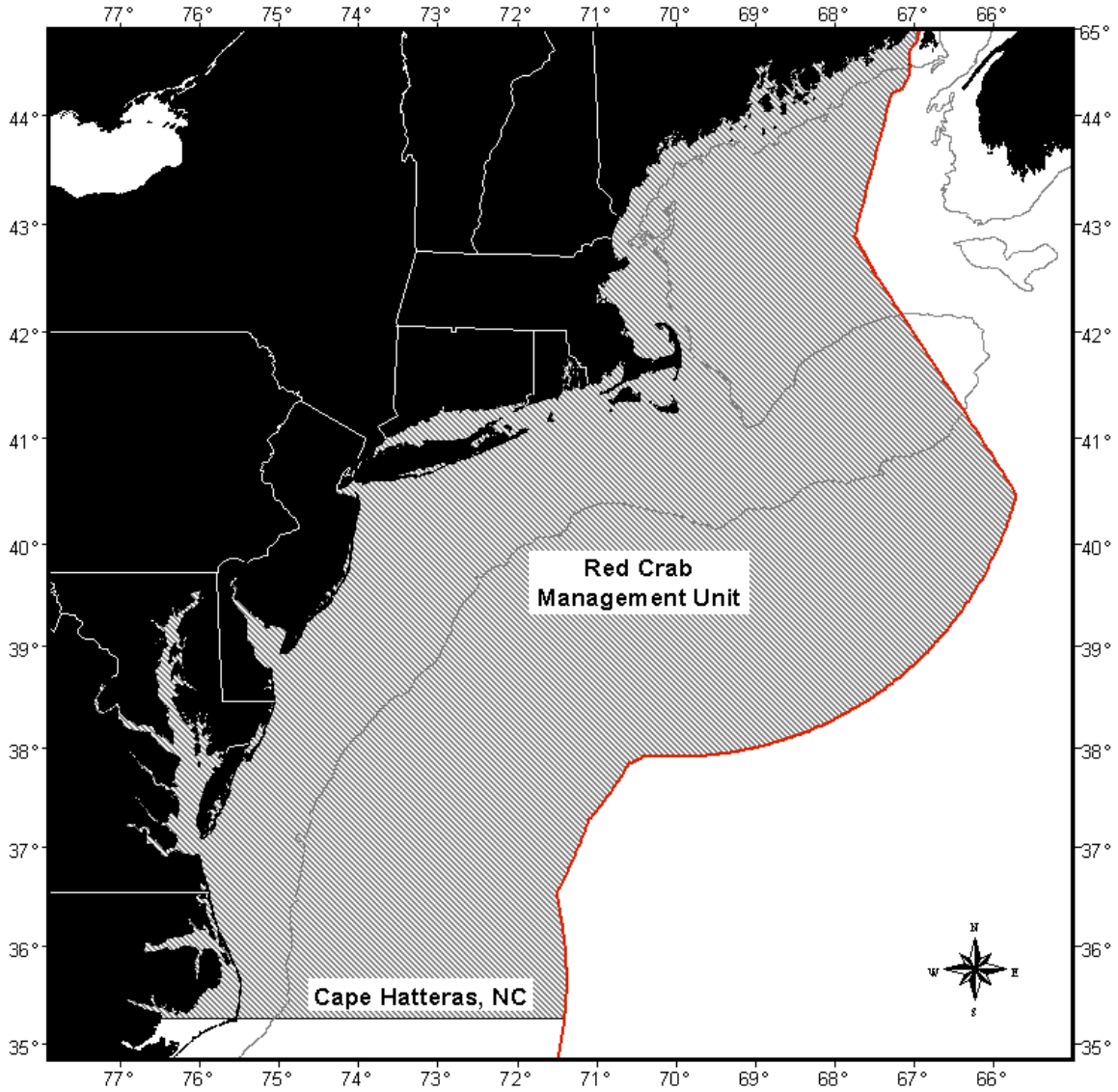

Figure 1: Map of the Red Crab FMP management unit. The shaded area represents the area within which the management measures identified in the Red Crab FMP apply.

Rationale: This is a single-species fishery with little to no interaction and/or bycatch of other managed or non-managed species; therefore only the target species need be included in the management unit. The proposed boundaries reflect the traditional extent of the red crab fishery in the Northeast U.S., are consistent with prior action taken by the Secretary of Commerce (the Emergency Regulations), incorporate a well-known biogeographic boundary (Cape Hatteras, NC), and are consistent with other New England Council FMPs. The other options considered by the Council would have arbitrarily split the traditional fishing area into a managed area and an area subject to no management.

It would not be practicable to manage this resource throughout its entire range, which would overlap not only the jurisdiction of the South Atlantic Fishery Management Council, but the Gulf of Mexico Council as well. Since what we are actually managing with this FMP is the red crab *fishery*, which in the Northeast is limited to the area north

of Cape Hatteras, NC, this is the most appropriate boundary for the management unit. The Gulf of Mexico Council is developing an FMP to manage deep-water crabs including red crab, but this fishery is economically and geographically distinct from the red crab fishery in the Northeast. Red crab is not a major component of the South Atlantic Council's golden crab fishery.

3.2.2 Non-Preferred Alternatives

3.2.2.1 Survey Boundary

An area about halfway between Baltimore and Washington Canyons (off the coast of the eastern shore of Virginia) was the southern extent of the 1974 R/V Albatross IV survey of the red crab population conducted by the Northeast Fisheries Science Center (NEFSC) (Wigley et al. 1975). The results of this survey include estimates of total red crab biomass in the survey area, total biomass of commercial-size red crabs in the survey area, and maximum sustainable yield (MSY) for the red crab resource in the survey area. The rationale for delineating the management unit according to the 1974 survey is that we could utilize the biomass and yield estimates derived from the survey data without the need to extrapolate to other areas not included in the survey. Limiting the management unit to the Survey Boundary would, however, leave an area where the fishery is known to be prosecuted without management. Since this is inconsistent with the goals and objectives of the FMP, this alternative was not selected.

3.2.2.2 Norfolk Canyon

Norfolk Canyon (off the coast of Virginia, east of Cape Charles) is just south of Washington Canyon and is believed to represent the southern extent of the directed red crab fishery. Delineating the management unit to just south of Norfolk Canyon would capture the entire known current fishing grounds, but would still leave some traditional and potential fishing areas without management. The South Atlantic Fishery Management Council has an FMP for golden crab (*Chaceon fenneri*) which extends to the Virginia-North Carolina border. Although not specifically included in the management unit for this FMP, red crab are occasionally caught in the golden crab fishery (SAFMC 1995). Because this fishery is related to the red crab fishery (golden crab is a closely related species that is also fished with traps in deep-water along the shelf and slope), if the management unit for the Red Crab FMP ends north of the Golden Crab FMP, there would be an area of the coast subject to deep-water crab fishing that is not under management. The administration and enforcement of regulations would be complicated by this shortfall. Limiting the management unit to Norfolk Canyon would leave an area where the fishery could be prosecuted without management. Since this is inconsistent with the goals and objectives of the FMP, this alternative was not selected.

3.2.2.3 Virginia/North Carolina Border

The Virginia-North Carolina border is the northern extent of the management unit for the South Atlantic Council's Golden Crab FMP. Choosing the Virginia-North Carolina border as the southern extent of the red crab management unit would therefore

be consistent with the existing Golden Crab FMP. Although red crab are not currently in the management unit for the Golden Crab FMP, they are included in the fishery. Thus, if at some point in the future landings of red crab in the South Atlantic golden crab fishery increased and some type of management action was required, the South Atlantic Council has a mechanism in place to deal with the issue. Limiting the management unit to the Virginia/North Carolina border would leave an area where the fishery could be prosecuted without management. Since this is inconsistent with the goals and objectives of the FMP, this alternative was not selected.

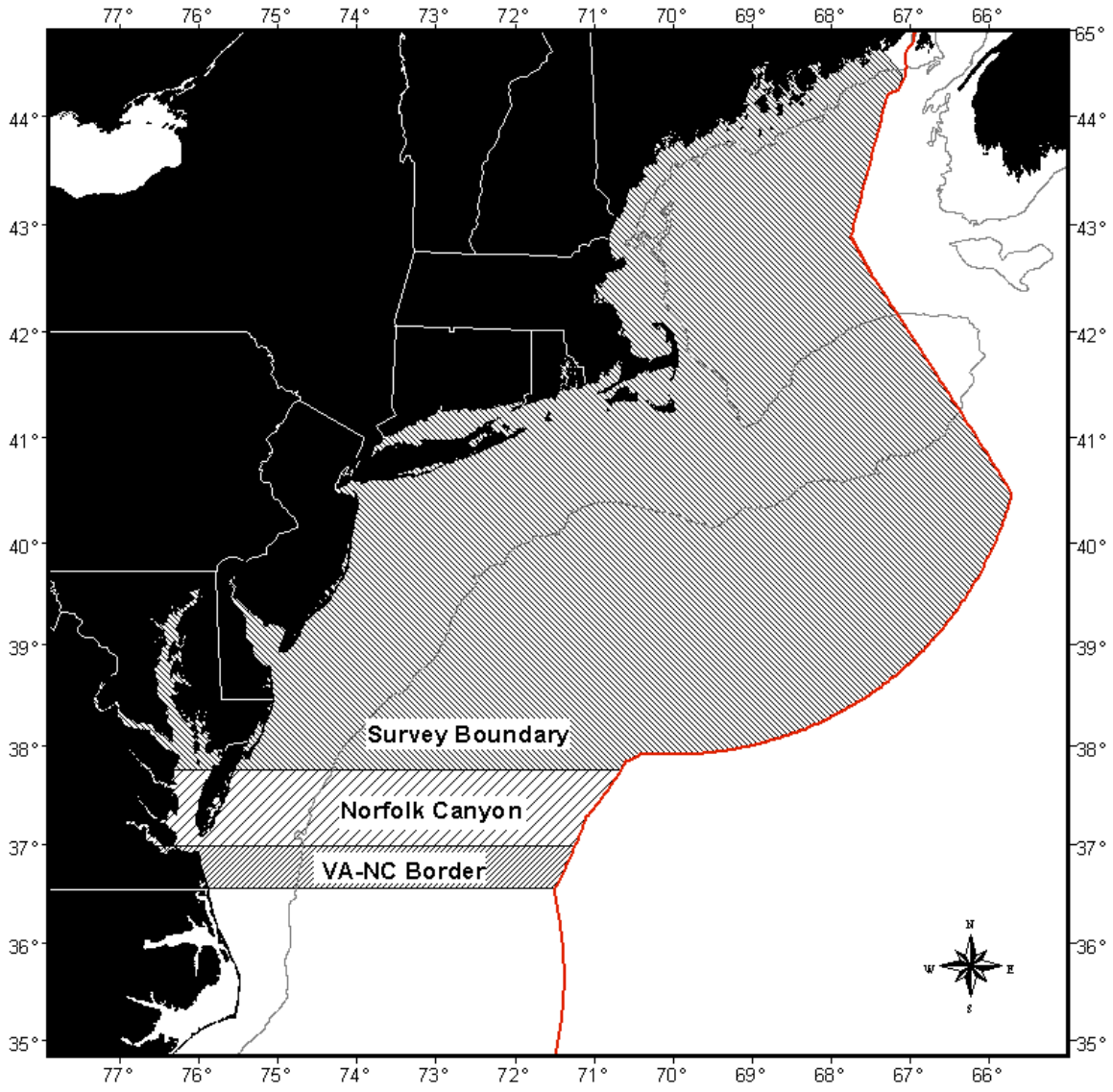

Figure 2: Map of Red Crab FMP management unit non-preferred alternatives. Each shaded area represents the proposed southern extent of a management unit alternative considered by the Council.

3.3 Fishing Year

The intent of establishing a formal fishing year for the Red Crab FMP is to create a clearly indicated start date for all new regulations and other controls or adjustments on the fishery that may take place on an annual schedule. This will also provide a clearly indicated end date for each fishing year for the purposes of management and tracking landings and fishing effort. The Council considered several alternatives for establishing the fishing year for this FMP.

3.3.1 Preferred Alternative: March 1

The red crab fishing year will start on March 1 of each year and end on the last day of February. This sets the fishing year based on times of relatively higher versus relatively lower landings of red crabs. Based on the management scheme selected by the Council (DAS with a target TAC), it appeared necessary or at least prudent to establish a fishing year offset from the calendar year so that the time between when preliminary information on the fishery for the current year and the implementation of adjusted management measures for the following year does not occur during a time of high red crab fishing effort and landings. If this were the case, and the Council were limited to preliminary information from a time of relatively low fishing effort, forecasts of likely future landings would be biased towards lower landings than what is likely to actually occur and the margin of error on all projections would be higher.

Figure 3 represents the cumulative percentage of the total annual landings harvested within six, seven, or eight months of the start month indicated. In this figure, the month is the hypothetical start of the fishing year. For example, the fishing year will begin on March 1, so based on historical landings patterns, we would expect the fishery to land approximately 60% of the total annual landings within six months of the start of the fishing year. Within eight months, we would expect the fishery to land almost 80% of their annual landings. This leaves only slightly more than 20% of the landings remaining to be harvested in the last one-third of the fishing year. If on the other hand, the fishing year began on September 1, six months later we would only expect the fishery to have landed 38% of their annual landings. Eight months after the September start of the fishing year, we would expect them to have landed only 59%.

Since this last one-third of the fishing year is the time in which the Council will be making decisions for any necessary annual adjustments for the fishery, the Council's decision-making will be much better informed if the majority of the fishing effort for the year has already occurred. More information would be available with which to make any necessary projections for landings and DAS usage or other measure of fishing effort, and determine whether an adjustment is needed to increase or decrease the TAC, DAS, or other fishing controls for the following year.

Rationale: The proposed start of the fishing year reflects traditional fishing practices and is prior to times of relatively higher effort and landings. The timing of the fishing year is anticipated to reduce the margin of error associated with projections made about future fishing years, and is consistent with other Council FMPs (e.g., Sea Scallop

FMP) which reduces the administrative burden on NMFS. Although a somewhat arbitrary decision, of all the possible fishing year start dates, March 1 makes the most sense. It is the same start date as for another Council FMP and it reflects the time after which the cumulative landings for the first six months of the fishery are expected to be the highest (see Figure 3).

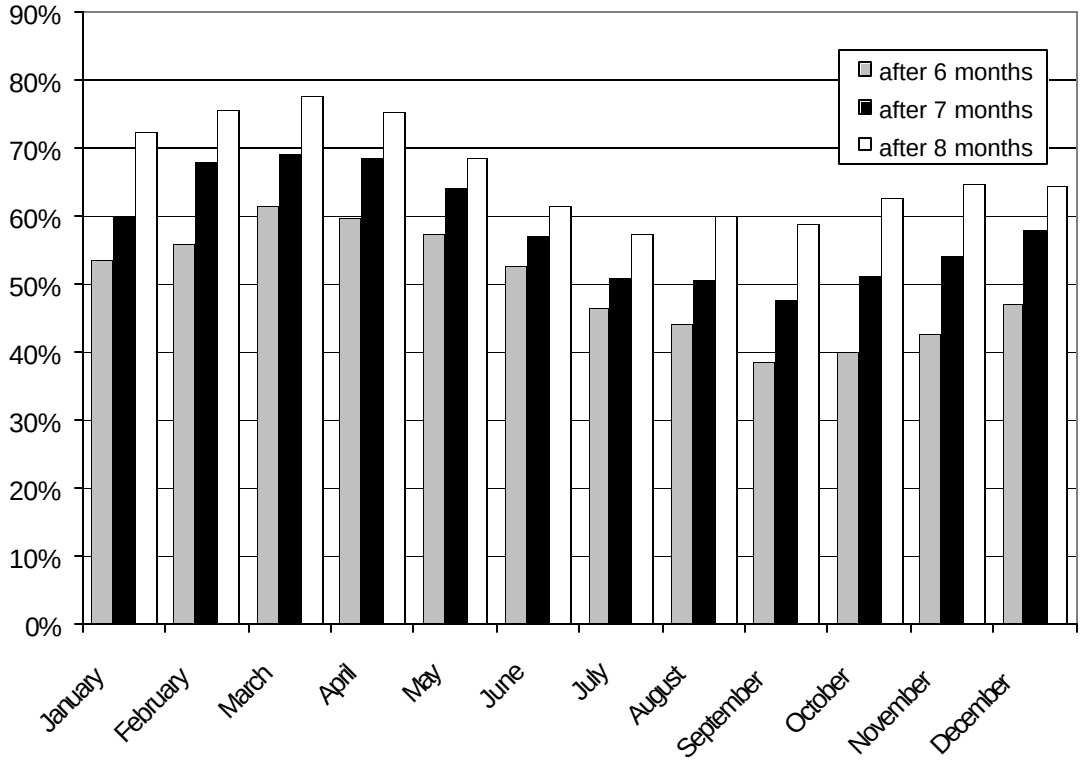

Figure 3: Cumulative percentage of annual landings by fishing year start month. This chart represents the cumulative percentage of the total annual landings harvested within six, seven, or eight months of the month indicated. The data are derived from the NMFS landings database, 1994 - 2000.

3.3.2 Non-Preferred Alternatives

3.3.2.1 Calendar-based Fishing Year

This alternative would set the fishing year equal to the calendar year, January 1 - December 31. All annual adjustment would be expected to be implemented on January 1, and landings and fishing effort would be tracked according to the calendar year.

3.3.2.2 Other FMP-based Fishing Year

This alternative would set the fishing year equal to and consistent with the fishing year of some other FMP (e.g., the Sea Scallop or Multispecies FMPs), for no other reason than to minimize the administrative burden. The Sea Scallop FMP specifies the fishing year as March 1 - February 28. The Northeast Multispecies FMP specifies the fishing year as May 1 - April 30. Other New England FMPs include the Atlantic Herring FMP (January 1 - December 31) and the Monkfish FMP (May 1 - April 30).

3.3.2.3 Quality-based Fishing Year

This alternative would set the fishing year based on times when the quality of red crabs is highest. This option presupposes that we will be able to determine a temporally consistent pattern in quality of red crab product. The Council would ideally be able to track red crab quality similar to what was done in Figure 3 for annual landings. Currently, these data are not available.

3.4 Estimate of Commercial Biomass and MSY

Maximum sustainable yield (MSY) for the portion of the red crab resource within the boundaries of the New England Council's management unit is estimated to be 6.24 million pounds, based on the following conditions:

(a) The biomass of male crabs only was considered in the estimation of MSY.

(b) Adult red crabs are assumed to recruit to the fishery when they reach 4" in carapace width.

(c) For the purpose of calculating MSY, the natural mortality rate is assumed to be 0.15.

Rationale: The red crab fishery traditionally targets, retains, and lands only relatively large male crabs. The Red Crab FMP will prohibit the retention and landing of female crabs in the directed fishery operating under the controlled access program. The traditional fishery only retains and lands large crabs and market constraints limit the acceptance of small crabs. A four inch carapace width is considered to be the smallest crab that would be retained by a vessel and accepted by the market. Although there is very little information on the natural mortality rate of red crabs, scientific information on similar species suggests that 0.15 is a satisfactory estimation. This estimate of MSY reflects the best available information on the biology of this resource species.

3.4.1 Total and Commercial Biomass

In 1974, NMFS conducted a directed survey of the red crab resource using the R/V Albatross IV. The results of this survey are available in a paper written by Wigley, Theroux and Murray (1975). Based on the data collected in this survey Wigley et al. estimated total commercial biomass at 59 million pounds. There was also a NMFS survey conducted in 1980 to test gear. Too few samples were collected and the survey did not cover much of the red crab range. Since this time there have been no further surveys of the red crab resource along the U.S. coast from the mid-Atlantic northward.

The only assessment ever done for this species was by Dr. Fred Serchuk in 1977. In this assessment, Serchuk (1977) utilized the data from the Wigley et al. (1975) survey. Because of the lack of any significant directed fishery for red crab prior to the 1974 Albatross IV survey, Serchuk assumed that the 59 million pound estimate of commercial biomass represented virgin biomass, from which he was able to derive an estimate for maximum sustainable yield (MSY).

It is important to consider the results of the Wigley et al. survey in the correct context. Wigley et al. (1975) assumed a minimum commercial size of 4½ inches (carapace width). Because they assumed this was the size at which an adult red crab would recruit to the fishery, the proportion of crabs smaller than 4½ inches was not included in the estimate of commercial biomass.

Wigley et al. (1975) developed an estimate of total biomass of red crabs (both sexes and all sizes) equal to 116.5 million pounds. The estimate of commercial biomass was based upon the percentage of all red crabs believed to be larger than the assumed minimum commercial size. Wigley et al. (1975) determined that 51% of the total biomass was represented by crabs larger than 4½ inches (59 million pounds). Of these, males represented 93% of the biomass, such that the biomass of commercial-sized males was estimated to be approximately 55 million pounds (Wigley et al. 1975). This is the amount (55 million pounds) that Serchuk used as the basis for his 1977 assessment.

Clearly, the size of red crab assumed to be the minimum commercial size is an important factor in the determination of the overall commercial biomass, which then has an effect on the basis for the estimate of MSY. If the minimum commercial size had been assumed to be smaller than 4½ inches, then the proportion of the total biomass represented by commercial sized crabs would have been more than the 51% determined by Wigley et al. (1975).

If we assume that there may be other sizes of red crabs that could represent the minimum size for the fishery, then by applying these alternative sizes at which red crabs would be considered to recruit to the fishery, we can calculate a range for the commercial biomass of the red crab population. For the purposes of the FMP, we have assumed that the minimum size of crabs harvested in the red crab fishery could be 4", 4 ¼", or 4 ½."[6] Using the size frequency information by area provided in Murray (1974) and Wigley et al. (1975), the PDT was able to calculate the percentage of the overall biomass that is represented by crabs larger than a given size. Table 3 shows the percentage of the total red crab biomass (as estimated by Wigley et al. as a result of the survey data) that would be considered exploitable (males and females) for each alternative minimum size.[7] This table also shows the amount of the red crab biomass that would be considered exploitable under each alternative minimum size.

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[6] All reports from members of the red crab fishing industry indicate that the fishery currently retains and lands all male crabs larger than 4". Thus, the range of minimum sizes considered here reflects current fishing practices, but also would reflect an increase in the size of crabs retained.

[7] In this discussion, the term "minimum size" does not necessarily mean a *regulated* minimum size (which would require the Council to implement a minimum size in this fishery and enforce this regulation), but should be considered the size at which red crabs recruit to the fishery. Since two of the three alternatives are larger than the current size crabs taken by the fishery, we have devised the term "*operational* minimum size" which would allow the Council to select a target minimum size for the fishery without establishing regulations to this extent.

Operational Minimum Size Alternatives	Exploitable Biomass as Percentage of Total Biomass	Estimate of Total Exploitable Biomass
4" CW	78.1 %	90.9 million pounds
4 ¼" CW	65.6 %	76.4 million pounds
4 ½" CW	50.5 %	58.8 million pounds

Table 3: Estimates of total exploitable biomass, depending on size. This table provides estimates of total exploitable biomass (both sexes) contained within the area surveyed by Wigley et al. (1975), depending upon the operational minimum size selected for the fishery, based on results of calculations performed by NEFSC using the Wigley et al. data. The Council's preferred alternative is 4" CW.

Wigley et al. (1975), in addition to calculating the amount of exploitable biomass including males and females, calculated the proportion of this exploitable biomass comprised by males only. Table 4 reproduces the calculations summarized in Table 3, but also determines the proportion of males represented by each alternative. Since the existing fishery retains and lands male crabs only, the *male-only exploitable* biomass is defined as the biomass of male red crabs estimated to be larger than the minimum size (*total exploitable* biomass, then, represents both males and females).

Operational Minimum Size Alternatives	Biomass of Males as Percentage of Exploitable Biomass	Estimate of Male-Only Exploitable Biomass
4" CW	79.8 %	72.5 million pounds
4 ¼" CW	89.0 %	68.1 million pounds
4 ½" CW	94.8 %	55.8 million pounds

Table 4: Estimates of male-only exploitable biomass, depending upon the operational minimum size selected for the fishery, contained within the area surveyed by Wigley et al. (1975) based on results of calculations performed by NEFSC using the Murray (1974) and Wigley et al. (1975) data.

3.4.2 Natural Mortality

The natural mortality rate (M) for the deep-sea red crab is currently unknown (Hastie 1995; Melville-Smith 1988a; Serchuk 1977). However, information is available for an assumed level of natural mortality (ASMFC 2001; Eldridge 1972; Melville-Smith 1988a; Serchuk 1977).

Eldridge (1972) estimated a rate of natural mortality for king crab (*Paralithodes* spp.) of 0.2. Serchuk (1977) applied this rate of M to his assessment of red crab, assuming somewhat similar life histories. In addition, there are other estimates of M

which could be used. In a series of papers from 1988 and 1989, Melville-Smith studied a similar species of deep-sea red crab (*Chaceon maritae*) off the coast of southwest Africa and estimated possible values of M for this species. There are several similarities between the African species of red crab and the Atlantic red crab, suggesting rates of natural mortality may be similar, as well:

(1) The species are from the same genus and are closely related. In fact, for many years *C. maritae* was actually considered to be *C. quinquedens*.

(2) Both species appear to utilize the same habitat in terms of depth and water temperature.

(3) The species share similar morphology in terms of overall appearance and carapace width to body weight relationship.

(4) The only evidence of differences between the species appears to be the suggestion that *C. quinquedens* may have a faster growth rate than *C. maritae*, but the evidence for a faster growth rate is not conclusive.

Melville-Smith (1988a) uses a range of estimates for M, equal to 0.05, 0.10, and 0.15. Melville-Smith reports that most studies of cold-water crabs and lobsters use low values (0.1 for *Homarus americanus* and *Jasus edwardsii*, and 0.14 for *Cancer pagurus*) and studies of warmer water crustaceans use higher values (0.14 - 0.52 for *Panulirus argus* and 0.226 for *Panulirus cygnus*). His use of values in the range of 0.05 - 0.15 for *C. maritae* presumed that the true value probably lies somewhere within that range.

For American lobsters, the natural mortality is partitioned into soft shell and hard shell components (ASFMC 2001). Lobsters that do not molt during a particular year have an M=0.10. Lobsters that molt once during a particular year have an M=0.15 and lobsters that molt twice during the year have an M=0.20. The total M for the stock depends on the proportion of lobsters in each molting category, and the average was calculated at between 0.13 - 0.15.

Choosing an appropriate estimate or range of estimates for M for the deep-sea red crab is obviously an important step in the FMP development process. Based on the available information, the Council may have to consider a range of values for M, much like those suggested by Melville-Smith, and proceed accordingly. Table 5 summarizes the range of alternatives for red crab natural mortality.

If we apply Melville-Smith's logic, then the true value of M for deep-sea red crab is probably somewhere in the total range of estimates (0.05 - 0.20). In addition to the four estimates provided by Melville-Smith and Serchuk, we have provided the mean of the estimates, M=0.125.

	Estimate of M	Source
Alternative 1	0.05	Melville-Smith (1988a)
Alternative 2	0.10	Melville-Smith (1988a)
Alternative 3	*0.125*	*Mean rate*
Alternative 4	0.15	Melville-Smith (1988a)
Alternative 5	0.20	Serchuk (1977)

Table 5: List of alternative estimates for natural mortality rate (M) for red crab based on available scientific literature. For the purposes of estimating MSY, the Council assumed that natural mortality is best reflected by Alternative 4, M = 0.15.

3.4.3 Maximum Sustainable Yield

In 1977, Serchuk completed an assessment of the red crab resource in the northwest Atlantic. This assessment provided an MSY estimate of 5.5 million pounds, assuming a male-only fishery targeting crabs 4½ inches and larger. The assessment was based on the data collected in 1974 during a NMFS survey of the red crab population in the Northeast (Wigley et al. 1975). The Wigley et al. survey included the area along the continental slope from eastern Georges Bank south to just south of Baltimore Canyon, east of the border between Maryland and Virginia. There are two issues about this survey and the resulting estimate of MSY related to the geographic range of the 1974 survey:

(1) A portion of the survey area from which the MSY estimate of Serchuk (1977) was developed now lies beyond the U.S.-Canadian border (the Hague Line) so that some of the assumed commercial biomass is not available to U.S. fishermen; and

(2) The likely fishable area extends beyond the Wigley et al. (1975) survey area to Cape Hatteras, North Carolina, but the biomass of red crabs in this area is not reflected in the estimate of MSY by Serchuk (1977).

A question to resolve is whether and how to adjust the estimate of MSY to better reflect the management unit. First, we can consider the portion of the survey area now east of the Hague Line. Wigley et al. (1975) estimated biomass in four geographic zones and within seven depth classes. Using the information in that paper (Figures 7 and 9 and Tables 9 - 12 *in* Wigley et al. 1975), 20.4% of the overall standing stock biomass and 30.5% of the commercial biomass come from the geographic zone intersected by the Hague Line. Plotting the coordinates of the Hague Line on the maps provided in the report demonstrate that approximately 25% of this geographic zone lies to the east of the Hague Line in what is now Canadian territory.

To get an estimate of biomass for the portion of the red crab stock on the U.S. side of the Hague Line, we take 75% of the biomass estimate for this geographic zone (Zone

D) and add it to the estimates for the other zones. The result is an estimate of total biomass (all sizes and sexes) of 110 million pounds and an estimate of total exploitable standing stock biomass (females and males larger than 4.5 inches carapace width) of 54 million pounds. These estimates of the size of the U.S. portion of the stock represent 94.9% and 92.4%, respectively, of the estimates provided in Wigley et al. (1975). Because the Council chose to incorporate this adjustment, the numbers in Table 3 and Table 4 were modified accordingly, as reflected in Table 6.

Operational Minimum Size Alternatives	Total Exploitable Biomass (Table 3)	U.S. Portion of the Stock (Minus Canada)	Adjusted Total Exploitable U.S. Biomass	Adjusted Male-Only Exploitable U.S. Biomass
4" CW	90.9 M pounds	94.9 %	86.3 M pounds	68.8 M pounds
4 ¼" CW	76.4 M pounds	94.9 %	72.5 M pounds	64.5 M pounds
4 ½" CW	58.8 M pounds	94.9 %	55.8 M pounds	52.9 M pounds

Table 6: Exploitable and commercial biomass of red crab, reduced for the Canadian portion of the stock (sample calculations: 86.3 = 90.9 × .949 and 68.8 = 72.5 × .949).

The second issue to resolve is the portion of the fishing grounds south of the area surveyed by Wigley et al. (1975). All of the biomass estimates were based on the 1974 survey that extended just south of Baltimore Canyon (see Figure 17). The directed fishery routinely extends at least as far south as Norfolk Canyon, and the management unit extends to Cape Hatteras, thus there is some amount of the fishable stock that is not incorporated into the biomass estimates outlined above.

One approach to deal with this issue is to use only the available estimates of biomass, based on the Wigley et al. (1975) survey, but consider these to be conservative estimates of biomass acknowledging that these under-estimate the true biomass. A second approach would entail determining the additional biomass of red crabs included in this additional area. There are a couple of methods that could be used to estimate the additional biomass from this area.

The first method to estimate an additional biomass for the area south of the Wigley et al. (1975) survey is to simply extend the results of the Wigley et al. survey to include this additional area. As described above, the Wigley et al. survey results were differentiated into four geographic zones (A - D, Figures 7 and 9 and Tables 9 - 12 *in* Wigley et al. 1975). Using this information, we can determine that 17.1% of the total biomass is attributed to the southernmost zone. If we assume that the density of red crabs in the additional area south of the survey is approximately the same as the density in this southernmost geographic zone, then we can apply this percentage to the unsampled area given an estimate of its relative area.

The southernmost geographic zone extends from Hudson Canyon to approximately halfway between Baltimore and Washington Canyons. The additional area extends from

the survey boundary to as far south as Cape Hatteras (depending on the alternative selected for the management unit). This is approximately 115.3% of the area of the southern survey zone (Zone A). We would assume, therefore, an additional 19.7% of the total biomass may be included to account for this additional area. If Cape Hatteras was not selected as the boundary of the management unit, then the additional biomass would have been adjusted accordingly (see Table 7).

Management Unit Alternatives	Percentage of Additional Biomass	Adjusted Total Biomass	Adjusted Male-Only Exploitable Biomass
Survey Boundary	0 %	116.51 M pounds	72.52 M pounds
Norfolk Canyon	8.65 %	126.59 M pounds	78.79 M pounds
VA - NC Border	11.63 %	130.06 M pounds	80.95 M pounds
Cape Hatteras	19.72 %	139.48 M pounds	86.82 M pounds

Table 7: Total and male-only exploitable biomass of red crab, adjusted for additional fishery area, assuming a 4" operational minimum size.

The second method to estimate the additional biomass would apply the results of other studies of red crab biomass from the additional area. The only known study on the segment of the red crab population located south of the Wigley et al. survey that attempted to estimate biomass or density was conducted by Haefner (1978). This study reported on the distribution and relative abundance of the red crab in the vicinity of the Norfolk Canyon. Haefner (1978) provides densities of red crabs for each of ten depth zones between 200 - 1800 meters. Ideally, we would be able to simply add the Haefner densities to those calculated by Wigley et al. (1975). However, this is not possible for several reasons:

(1) The Haefner survey used a trawl only while the Wigley et al. survey used a trawl and a camera system. Wigley et al. compared the densities calculated from the trawl component of the survey and the camera component and reported that the trawl densities varied considerably from the camera densities, ranging from 19.1% of the camera density to 78.4% of the camera density, depending on depth and location. This suggests that the Haefner densities are underestimates of true density, but the amount of underestimation is not known with sufficient precision to be used.

(2) The Haefner survey used a different and larger trawl than the trawl used by the Wigley et al. survey, and may not have sampled as efficiently as the trawl in the Wigley survey. The differences in trawl size and design further complicate attempts to compare the results of the two studies.

(3) The observed differences in the average densities of red crabs between the two studies could be a result of incomplete or inefficient sampling in the Haefner

survey, or could be a result of real differences in crab abundance.

For these reasons, Haefner himself concluded that the two studies could not be combined to get an overall estimate of stock size. In addition to the above limitations of a comparison between the Haefner and the Wigley et al. surveys, the Haefner study does not develop an estimate of biomass for the red crabs in the Norfolk Canyon area, but stops at reporting observed densities. Also, the Haefner study is limited in its applicability as it only surveyed the red crabs in the direct vicinity of Norfolk Canyon and does not provide any insight into the segment of the red crab population south of Norfolk Canyon. It should be recognized that any attempt to develop an estimate of the additional biomass represented by the area of the management unit south of the boundary of the Wigley et al. (1975) will be an estimate only and will have a fairly high degree of uncertainty associated with it.

The only assessment and estimate of MSY for red crab was done by Serchuk (1977). The basis for this assessment and estimate of MSY was to take the available estimate of commercial biomass and incorporating it into Gulland's equation (Gulland 1971) for virgin stock exploitation. The equation appears as:

$$MSY = 0.5 * M * B_0$$

where M = natural mortality rate, and
B_0 = virgin biomass of commercial sized crabs

The two key elements of this calculation are the rate used for M and the biomass of commercial sized crabs. The above discussion identified the alternatives available for a estimate of M that would result in a different estimate of MSY as well as the alternatives available for how to calculate the commercial biomass. Depending on the combination of natural mortality rate and commercial biomass as described above, there is a wide range of estimates of MSY that would serve as the basis for many management measures. Table 8 provides this range for each of the possible operational minimum sizes, rates of M, and management unit boundaries considered. Based on the decisions of the Council, the MSY for red crab is estimated to be 6.24 million pounds.

The Wigley et al. (1975) survey also did not consider the Gulf of Maine portion of the red crab stock. The red crabs that occur in the Gulf of Maine are smaller than those that occur along the continental slope, the occur there in lower density, and the habitat of the Gulf of Maine is not ideal for the deep-sea red crab. For these reasons, fishermen actively avoid fishing in the Gulf of Maine. For these reasons, any red crabs that occur in the Gulf of Maine are not considered in this FMP.

Operational Minimum Size	Natural Mortality Rate Options	Management Unit Alternatives			
		Survey Boundary MSY	Norfolk Canyon MSY	VA-NC Border MSY	**Cape Hatteras MSY**
4" CW	0.05	1.72 million pounds	1.88 million pounds	1.93 million pounds	2.08 million pounds
	0.10	3.44 million pounds	3.76 million pounds	3.87 million pounds	4.16 million pounds
	0.125	4.31 million pounds	4.70 million pounds	4.83 million pounds	5.20 million pounds
	0.15	5.17 million pounds	5.64 million pounds	5.80 million pounds	**6.24 million pounds**
	0.20	6.89 million pounds	7.52 million pounds	7.74 million pounds	8.32 million pounds
4 ¼" CW	0.05	1.61 million pounds	1.76 million pounds	1.81 million pounds	1.95 million pounds
	0.10	3.23 million pounds	3.52 million pounds	3.62 million pounds	3.90 million pounds
	0.125	4.03 million pounds	4.40 million pounds	4.53 million pounds	4.87 million pounds
	0.15	4.84 million pounds	5.28 million pounds	5.43 million pounds	5.85 million pounds
	0.20	6.45 million pounds	7.04 million pounds	7.25 million pounds	7.80 million pounds
4 ½" CW	0.05	1.32 million pounds	1.44 million pounds	1.48 million pounds	1.60 million pounds
	0.10	2.65 million pounds	2.89 million pounds	2.97 million pounds	3.20 million pounds
	0.125	3.31 million pounds	3.61 million pounds	3.71 million pounds	3.99 million pounds
	0.15	3.97 million pounds	4.33 million pounds	4.46 million pounds	4.79 million pounds
	0.20	5.29 million pounds	5.78 million pounds	5.94 million pounds	6.39 million pounds

Table 8: Summary of the estimates of MSY for the male-only red crab fishery depending upon the selection of an operational minimum size, an estimate of the natural mortality rate, and the southern boundary of the management unit. The overall range of MSY estimates is 1.32 - 8.32 million pounds. Based on the Council's preferred alternatives for the minimum commercial size, the rate of natural mortality, and the southern extent of the management unit, MSY is calculated to be 6.24 million pounds.

3.5 Overfishing Definition[8]

3.5.1 Overview

The Magnuson-Stevens Act includes a requirement that all FMPs "specify *objective and measurable criteria* for identifying when the fishery to which the plan applies is overfished." The National Standard Guidelines (NSGs) require the specification of "status determination criteria" (63 FR 24212). These criteria are to be "expressed in a way that enables the Council and Secretary to monitor the stock or stock complex and determine annually whether overfishing is occurring and whether the stock or stock complex is overfished." To comply with the Magnuson-Stevens Act and the National Standard Guidelines, the Council must develop more than a simple "overfishing definition" for this resource.

The National Standard Guidelines define overfishing, overfished, and other terms and required components of an FMP. According to the NSGs, an *overfished* stock is one "whose size is sufficiently small that a change in management practices is required in order to achieve an appropriate level and rate of rebuilding." A stock is considered overfished when its size falls below the minimum stock size threshold (MSST). The Magnuson-Stevens Act requires a rebuilding plan for stocks that are overfished. According to the NSGs, *overfishing* "occurs whenever a stock or stock complex is subjected to a rate or level of fishing mortality that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis." Overfishing is considered to be occurring if the maximum fishing mortality threshold (MFMT) is exceeded for one year or more.

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[8] This section of the FMP includes many technical terms that may be unfamiliar to some readers. These terms are defined below (as well as in the Glossary):

B. Biomass, measured in terms of total weight, spawning capacity, or other appropriate units of production.

B_0. Virgin stock biomass, i.e., the long-term average biomass value expected for the stock in the absence of fishing. In the FMP, B_0 is used as the biomass of red crabs prior to the onset of commercial fishing for this resource.

B_{msy}. Long term average exploitable biomass of male red crabs that would be achieved if fishing at a constant fishing mortality rate equal to F_{msy}.

CPUE. Catch-per-unit-effort, or in this FMP, the average number of marketable red crabs caught per trap, where a single trap haul is considered the standard unit of fishing effort.

F. Instantaneous fishing mortality rate. Measures the effective fishing intensity for a given partial recruitment pattern.

F_{msy}. Fishing mortality rate which, if applied constantly, would result in MSY.

M. Instantaneous natural mortality rate.

MFMT. Maximum fishing mortality threshold. This is the reference point for determining if overfishing is occurring.

MSST. Minimum stock size threshold. This is the reference point for determining if the stock is in an overfished condition.

MSY. Maximum sustainable yield. The largest long-term average yield (catch) that can be taken from a stock under prevailing ecological and environmental conditions.

The NSGs require that both an MSST and an MFMT be specified. If these specific criteria cannot be specified due to data and information limitations, then reasonable proxies must be specified. In addition, the NSGs suggest the development of a *control rule*. A control rule describes a variable (such as fishing effort) over which management has some direct control, as a function of some other variable(s) related to the status of the stock (such as biomass). The standard, default control rule describes fishing mortality rates and current biomass levels (Restrepo et al. 1998).

The control rule does not have to be cast in these terms, however. The control rule's basic function is to be able to compare an available measure of stock status with some basic biological reference points, as well as to indicate the direction management should take under "bad" or "good" conditions. The following figure represents the "default" control rule as described in Restrepo et al. (1998).

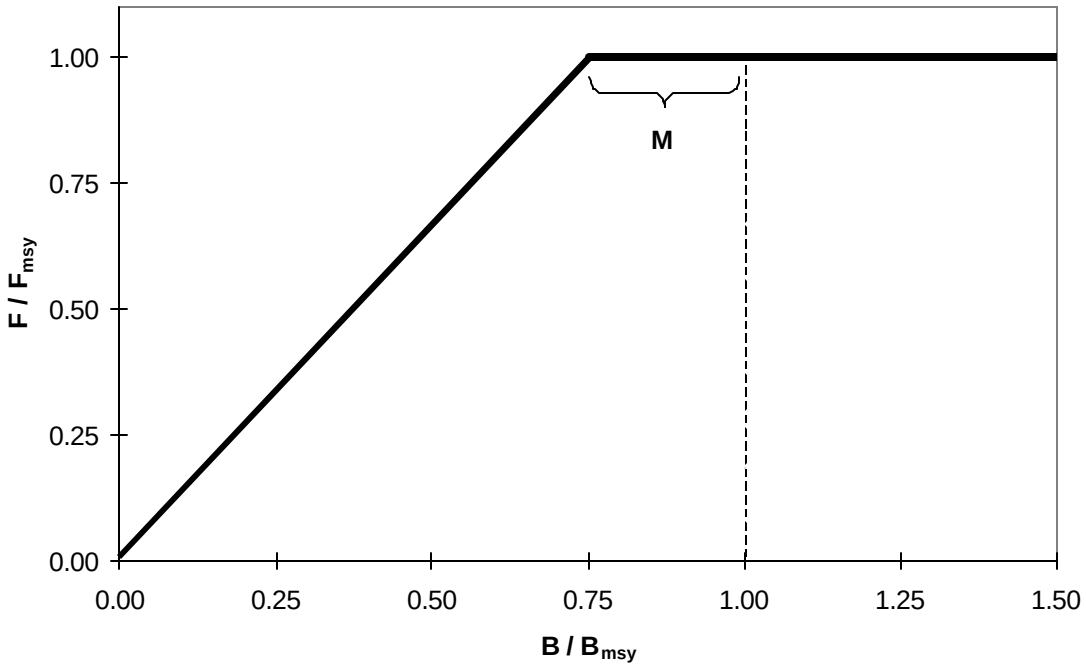

Figure 4: "Default" MSY control rule (Restrepo et al. 1998). "M" is defined as the natural mortality rate, "F" as the fishing mortality rate, and "B" as biomass.

In Figure 4, biomass and fishing mortality are indicated by a ratio of current biomass or fishing mortality compared to the biomass or fishing mortality rate that would occur under MSY conditions. M represents the natural mortality rate, such that fishing mortality rate is not reduced until the biomass reaches a level equivalent to $(1-M)*B_{msy}$. Use of this control rule requires a good estimate of B_{msy}, a current measure of B, a good estimate of F_{msy} and a current measure of F.

As stated above, the Magnuson-Stevens Act allows for the use of proxies in situations where there is insufficient knowledge to develop the above estimates and measures. Proxies are generally required when the MSY-related parameters (such as B,

B_{msy}, F, and F_{msy}) cannot be estimated from the available data (Restrepo et al. 1998). Proxies are also used when the estimated values for the MSY parameters are deemed to be unreliable. A full discussion of this topic is available in Restrepo et al. (1998). Basically, the use of proxies depends in large part upon the availability of data with which to make status determinations. Data-rich cases would not require proxies, but data-moderate and data-poor cases would (Restrepo et al. 1998).

The following sections describe the Council's preferred and non-preferred alternatives for determining when overfishing may be occurring, when the stock is in an overfished condition, the control rule and reference points to be used in making these determinations.

3.5.2 Overfishing Definition Preferred Alternative

The Council considered several alternatives for an appropriate combination of an overfishing definition, a control rule, and a set of measurable reference points to be used to determine whether the resource is in an overfished condition or whether overfishing is occurring. The Council developed several alternatives for an *overfishing* definition to be used in this FMP. It is important to note that this definition will only indicate when overfishing is occurring, not necessarily when the stock is in an overfished condition. To make a determination as to whether the stock is overfished, we must apply the control rule and utilize the status determination criteria and reference points. Because the control rules and reference points are to some degree tied to the proxies that may be required, and these are in turn somewhat tied to the overfishing definition, all of these elements were bundled together in each of the alternatives considered by the Council.

Definition of Overfishing: Overfishing is defined as any rate of exploitation such that the ratio of current exploitation to an idealized exploitation under MSY conditions exceeds a value of 1.0. The actual measure of exploitation used will be determined by the availability of suitable data (CPUE data, landings, etc.).

This alternative does not establish a fixed measure against which to compare current fishing pressure, or exploitation. Rather, it establishes a ratio value against which several different measures or proxies could be compared. Choice of the particular measure or proxy to be used in an assessment would be left to the assessment team, based on a clearly identified set of criteria and conditions under which each type of measure or proxy may be used. The list of proxies from which to choose and the likely conditions to be specified for each are described below.

Definition of Overfished: The red crab stock will be considered to be in an overfished condition if one of the following three conditions are met:

> Condition 1 -- The current biomass of red crab is below ½ B_{msy} in the New England Council's management area.
>
> Condition 2 -- The annual fleet average CPUE, measured as marketable crabs landed per trap haul, continues to decline below a baseline level for three or more consecutive years.

Condition 3 -- The annual fleet average CPUE, measured as marketable crabs landed per trap haul, falls below a minimum threshold level in any single year.

Reference Points: To implement this alternative, estimates of an exploitation rate and biomass level that would exist under MSY-level conditions are required, as are measures of current exploitation and B. If these estimates and/or measures are not available or are unreliable, reasonable proxies are required. Under this alternative, appropriate proxies for MSY-level exploitation would include either the best estimate of the relationship between MSY and the CPUE that would occur under MSY conditions, or simply a level of landings equal to MSY. To gauge current exploitation, suitable proxies would include either a measure of the relationship between current landings and current CPUE, or simply a measure of current landings. These proxies are further explained below.

Proxy #1: f / f_{msy} -- It is common for data sparse stocks to estimate trends in fishing mortality as an exploitation ratio, i.e., landings or catch divided by an index of abundance, usually from a survey. As a proxy for F_{msy}, Councils in the past have selected an exploitation level that existed during a time with no trend in biomass at an intermediate biomass level. Sometimes this has been augmented by an estimate of absolute MSY from another source of information to determine a suitable index-based proxy for B_{msy}. Thus, the following equations apply:

$$f_{msy} = L_{msy} / I_{msy} \text{ or } MSY / I_{msy} \quad (a)$$

where: f_{msy} is an MSY exploitation index; L_{msy} are the landings during the period thought to approximate MSY conditions; and I_{msy} is the survey biomass index during the same period. If a suitable sub-fleet can be identified or standardization method can be developed, the commercial CPUE could replace I_{msy} from a fishery independent survey. Care should be taken to ensure that the unit of effort is robust or this method could give misleading results. Using the above equation and substituting standardized CPUE gives:

$$f_{msy} = L_{msy} / CPUE_{msy} \text{ or } MSY / CPUE_{msy} \quad (b)$$

To create a ratio of current fishing effort compared to idealized fishing effort under MSY conditions, apply the above formula (b) but simply replace the MSY controls with current estimates of the measures. This gives the formula:

$$f = L / CPUE \quad (c)$$

where L represents the current landings and CPUE represents the current catch rates. The ratio used in this approach could then be defined as follows:

$$f : f_{msy} = \frac{L}{CPUE} : \frac{MSY}{CPUE_{msy}} \quad (d)$$

The advantage of this approach is it allows for the use of available landings and CPUE data from the fishing industry (assuming these data are reliable and accurate) to determine relative fishing effort. This approach does not rely on calculating an accurate

fishing mortality rate. The disadvantage of this approach is that it requires accurate and consistent reporting of catch data. Reliable landings and effort data should be available, using dealer data augmented by records from fishermen. Effort would be defined as the number of marketable crabs landed per trap haul. If we are able to meet the conditions necessary for this approach to work, this index could be suitable indicator of relative fishing effort.

Proxy #2: L / MSY -- If we are not able to implement the above indicators of fishing effort, the data will exist to implement the most crude method. To serve as a ratio of current fishing effort to an idealized fishing effort under MSY conditions, we could simply compare current landings to our best estimate of MSY. When this ratio of L:MSY is greater than one, obviously landings have exceeded MSY and overfishing would be occurring. When the ratio is less than one, then landings are less than MSY and overfishing would not be occurring. Although quite crude, if data availability conditions prevent us from using the previous index, this index would provide at least some indication of current fishing effort relative to MSY conditions.

B_{msy} can be estimated at a variety of percentages of B_0, and $40\%B_0$ is often recommended (Restrepo et al. 1998). To fully implement this alternative, either a measure of current biomass or a measure of current CPUE are also required. If current biomass is not available, then a measure of CPUE would be used (conditions 2 or 3). Both CPUE conditions require a baseline level of CPUE against which to measure current CPUE. Ideally, the baseline CPUE would be the CPUE that would occur under MSY conditions. Unfortunately, historic CPUE data from the fishery are inconsistent and unreliable. Available data from 1997 suggest an average CPUE of approximately 25 marketable crabs per trap haul. Reported landings in 1997 totaled 4.5 million pounds, approximately 82% of our best estimate of MSY. In this case, $CPUE_{msy}$ becomes the baseline and if current CPUE continues to decline for three years below this level, the resource would be considered as overfished.

Another approach is to calculate a comparable CPUE that occurred under virgin stock conditions. In 1974, several studies on red crabs were conducted by a variety of groups and individuals (Ganz and Herrmann 1974; Lux et al. 1982; Wigley et al. 1975). Ganz and Herrmann (1974) explored several aspects of the developing red crab fishery off southern New England, including observations of commercial fishing trips, the size structure of the population, and responses to changes in water temperature. Lux et al. (1982) began a tagging study on red crabs off southern New England in 1974 in an attempt to study molting frequency and commercial catch rates. Wigley et al. (1975) conducted a comprehensive bottom trawl and photographic survey of the red crab population in an attempt to determine population size, structure and distribution.

Because of the infancy of the directed red crab fishery (it had just begun in 1973, with less than 250,000 pounds of reported landings), the characterization of the population from the 1974 survey is interpreted as representing virgin stock conditions. Thus, we are using the overall commercial biomass calculations from this survey as equal to virgin biomass (B_0). The other studies conducted in this same year offer additional measures which can serve as an indication the stock under virgin conditions. For

example, both Ganz and Herrmann (1974) and Lux et al. (1982) calculated CPUEs for the fishing vessels operating at this time.

By combining the information provided in both of these papers, an approximate average CPUE for market-size males can be derived for the stock under virgin conditions. The results of this calculation suggest that a range of 26 - 29 represents an optimal catch of males greater than 4 ½" CW per trap during virgin stock biomass conditions.[9] This range could be called $CPUE_0$, if it can be adjusted to represent the current commercial size crabs (> 4" CW). In order to apply this figure as a baseline against which to compare today's fishery, we have to make a couple of assumptions. First, we have to assume that the fishermen working in 1974 were fishing in areas similar to the locations visited by fishermen today. Second, we have to assume that the gear being used in 1974 was similar in size, design, and catchability as the gear being used by fishermen today.

To address the first assumption, we can compare the locations of the surveys, which both were reported to occur off the coast of southern New England in the depth range from 366 meters to 823 meters. The fishermen today report fishing most frequently within 400 - 800 meters, so this is fairly comparable. Although the fishery today has expanded to target the southern slope of Georges Bank and the Mid-Atlantic as far south as Norfolk Canyon, most of the fishing effort appears to continue to be focused on the southern New England area. To address the gear assumption, it is impossible to know whether the gear used in 1974 is the same as the gear used today. However, we can say that the gear used in 1974 was reported to be a slight modification of the offshore lobster pot (Ganz and Herrmann 1974). Similar gear is appears to be used today, as the most common gear in the fishery remains a rectangular 48" × 30" wood and wire trap with a top entry. Thus, although the gear used today might fish somewhat differently than the gear that would have been used in 1974, the results of this analysis probably provide at least a reasonable approximation of CPUE under virgin stock conditions for comparison with current catch rates.

If the above analysis and assumptions are accepted, then the suggested CPUE baseline is between 26 and 29 market-size crabs per trap, before being adjusted for 4" CW market-size crabs. Incorporating this baseline allows us to develop the following threshold reference points for this alternative:

- $f : f_{msy} > 1 =$ This would be overfishing if proxy 1 is used ($MFMT_{ratio} = 1$).
- $\frac{L}{MSY} > 1 =$ This would be overfishing if proxy 2 is used ($MFMT_{landings} =$

[9] Lux et al. (1974) reported observing commercial fishing trips where 224,000 crabs total were harvested and 117,000 of these (52.2%) were market-size males (> 4 ½" CW). Ganz and Herrmann (1974) reported that the optimal soak time for this fishery appeared to be in the range of 18-24 hours, when catch ranged from 50-55 total crabs per trap haul. If we apply Lux et al.'s percentage of market-size males to the total catch per trap from Ganz and Herrmann, we get approximately 26.1 - 28.7 market-size males per trap haul.

MSY).

- $B < ½B_{msy}$ = This is the threshold level for being overfished, if current biomass data are available ($MSST_{Biomass} = ½ B_{msy}$).

- $CPUE < ½CPUE_0$ = This is the threshold level for being overfished if current CPUE has been continuing to decline below this level for three or more years ($MSST_{CPUE-1} = ½ CPUE_0$).

- $CPUE < ¼CPUE_0$ = This is the threshold level for being overfished if the current CPUE declines below this level in one any year ($MSST_{CPUE-2} = ¼ CPUE_0$).

This alternative incorporates the likelihood of available data with a range of possible conditions under which various proxies for stock status and/or fishing effort can be used.

Control Rule: While the form of the control rule will look the same as the default MSY-control rule described in Restrepo et al. (1998) (Figure 4), the measures comprising the x and y axes will obviously be different and will depend upon the availability of data at the time of the assessment.

3.5.3 Non-Preferred Overfishing Definitions

3.5.3.1 Non-Preferred Alternative 1

Definition of Overfishing: Overfishing is defined as any rate of fishing mortality (F) in excess of F_{msy} for deep-sea red crab in the New England Council's management area.

This alternative provides an overfishing definition used in many fisheries; however, this definition assumes a good estimate of F_{msy} and an accurate measure of current F. If a good estimate of F_{msy} is not available then a proxy is needed. Similarly, if an accurate measure of current F is not available then a proxy is needed. Choice of an appropriate proxy is data dependent, and may require changing the overfishing definition to better represent the proxy being used. Depending on the quality of these proxies, the resulting status determination may or may not accurately reflect current fishing pressure on the resource. The degree to which the status determination accurately reflects current conditions in the fishery depends upon the choice of the proxy, the availability of data with which to calculate the proxy, the accuracy and precision of the data used to calculate the proxy, and the timeliness of the data used to calculate the proxy.

Definition of Overfished: The red crab stock will be considered to be in an overfished condition if the biomass of red crab falls below $½ B_{msy}$ in the New England Council's management area.

This alternative provides a definition for overfished that is used in many fisheries; however, this definition assumes a good estimate of B_{msy} and an accurate measure of current B. If a good estimate of B_{msy} is not available then a proxy is needed. Similarly,

if an accurate measure of current B is not available then a proxy is needed. Choice of an appropriate proxy is data dependent, and may require changing the definition of overfished to better represent the proxy being used. Depending on the quality of these proxies, the resulting status determination may or may not accurately reflect current status of the stock. The degree to which the status determination accurately reflects current stock conditions depends upon the choice of the proxy, the availability of data with which to calculate the proxy, the accuracy and precision of the data used to calculate the proxy, and the timeliness of the data used to calculate the proxy.

Reference Points: To implement this alternative, estimates of F_{msy} and B_{msy} are required, as are measures of current F and B. If these estimates and/or measures are not available or are unreliable, reasonable proxies are required. Typical proxies for F_{msy} include F_{max}, $F_{0.1}$, F_{med}, or $F_{\%SPR}$. F_{max} and $F_{0.1}$ both require development of an equilibrium yield per recruit model (YPR) that corresponds to various levels of F. F_{med} and $F_{\%SPR}$ both require development of an equilibrium spawning output per recruit (SPR) model that corresponds to various levels of F. Currently, neither a YPR model or a SPR model are available for deep-sea red crab.

B_{msy} can be estimated as a variety of percentages of B_0, and $40\%B_0$ is often recommended (Restrepo et al. 1998). Threshold reference points at which management action must be taken are often in the form of:

- $F > F_{msy}$ = This is indicated as overfishing (MFMT = F_{msy}).
- $B < ½B_{msy}$ = This is a typical threshold level for being overfished (MSST = ½ B_{msy}).
- $B < ¼B_{msy}$ = This is an alternative biomass threshold for highly resilient stocks (MSST = ¼ B_{msy}).

The main issue with this alternative for the Red Crab FMP is the lack of data with which to estimate current F and the fact that survey data with which to calculate current B are not likely to be consistently available, if they are available at all. This approach, although the standard methodology for many FMPs, appears to be unsupported by the available data and information on this fishery and the resource.

Control Rule: When using the standard approach outlined in this alternative, the form of the control rule can often be a derivation or slight modification of the default MSY-control rule described in Restrepo et al. (1998) (Figure 4). When using this control rule, any of the above described proxies can be substituted for the default measures and the threshold reference points are as described above. Any time current biomass is less than $(1\text{-}M)*B_{msy}$, F should be reduced through some management action to avoid a continued decline in stock biomass. Once biomass declines below the minimum threshold, a rebuilding plan would be required.

3.5.3.2 Non-Preferred Alternative 2

Definition of Overfishing and Overfished: Overfishing and overfished are defined to be

occurring at any time that the annual fleet average catch-per-unit-effort (CPUE), measured as marketable crabs landed per trap haul, continues to decline below a baseline level for three or more consecutive years, or if, in any one year, it falls below a minimum threshold level.

This alternative depends entirely upon consistent and accurate reporting of catch data. The concept is that if catch rates have been in decline for a period of time, then fishing effort is probably exceeding sustainable levels. Thus, under this option, if a decline in CPUE below a baseline level is observed to continue for three or more consecutive years, we would consider the fishery to be overfishing the resource. There are several limitations of this approach. First, changes in CPUE (up or down) may occur without any relationship to stock conditions if fishing techniques, technologies, or the number of participants changes. Similarly, real changes in fishing effort could be masked by changes in fishing techniques or technologies that result in the appearance of a flat CPUE trend.

This alternative presumes that a persistent reduction in CPUE is a direct reflection of fishing pressure (i.e., this alternative and measure in effect serve as proxies for an evaluation of fishing mortality rate). Since under ideal conditions we are trying to maintain a balance between an adequate stock size (target $\geq B_{MSY}$) and a reasonable amount of fishing pressure (target $\leq F_{MSY}$), a sustained rate of fishing mortality above F_{MSY} when the stock is at B_{MSY} is considered overfishing because ultimately this level of effort will result in a reduction in stock size to below B_{MSY}. If the stock is at a level less than B_{MSY}, then fishing mortality should also be reduced to below F_{MSY} by a comparable amount to prevent further reductions in stock size. Thus, the level of effort at which overfishing occurs may vary with stock size. Ideally, then, the measure of fishing effort used to determine if overfishing is occurring is independent of stock size, yet the threshold is tied to stock size.

However, the approach suggested in this alternative does not reflect this. In this case, the threshold is independent of stock size, yet the measure is totally dependent upon stock size. Overfishing would only appear to occur when the stock size was reduced to levels such that catch rates declined overall. Theoretically, fishing effort could be dramatically reduced yet because the stock declined, even a minimal amount of fishing effort would appear as overfishing. This alternative, although suggested as a potential overfishing definition, may be more appropriate as an indicator of stock size (and thus a reference point for a fishery-dependent-data based control rule).

Another concern with this alternative is that, because of the considerations identified above, there would be no way to differentiate when overfishing is occurring from when the stock is overfished. Since a rebuilding plan is required (under the Magnuson-Stevens Act) anytime a stock is overfished, as soon as it was indicated that overfishing was occurring according to this alternative, a rebuilding plan would also be required. This eliminates the possibility that the Council could use an overfishing determination to reduce fishing effort before the stock levels decline to the point of requiring a rebuilding plan.

This alternative also locks in place the type of measure and the data required to determine the status of the fishery. If CPUE data are not available, are suspect for one of the reasons outlined above, or if data that would provide a more robust measure of exploitation rate become available, the status determination and overfishing definition can only be changed through a formal change to the FMP.

Reference Points: To implement this alternative, the only measures necessary are a current CPUE and a baseline CPUE against which to compare. The baseline CPUE ($CPUE_0$) is derived as explained in the previous alternative. Threshold reference points at which management action must be taken would be in the form of:

- $CPUE < ½CPUE_0$ = This is the threshold level for overfishing and for being overfished if current CPUE has been continuing to decline below this level for three or more years.

- $CPUE < ¼CPUE_0$ = This is the threshold level for overfishing and for being overfished if the current CPUE declines below this level in one any year.

Control Rule: Due to the nature of this alternative -- the CPUE measure indicates both overfishing and when the stock is in an overfished condition -- there is no control rule appropriate for this alternative.

Table 9 summarizes the above alternatives by displaying the criteria used to assess the status of the fishery and the stock, the threshold reference points, available proxies, and the actions that would be required by the Council if the thresholds are violated.

Alternative	Status	Criteria	Reference Point	Proxy	Remedy if Threshold Exceeded
Preferred Alternative	Overfishing	f	$f:f_{MSY} > 1$	$\frac{L}{CPUE} : \frac{MSY}{CPUE_{MSY}}$	Reduce landings.
				$\frac{L}{MSY}$	Reduce landings.
	Overfished	B	$B < ½ B_{MSY}$	None.	Rebuilding plan.
		CPUE	$CPUE < ½ CPUE_0$	N/A	Rebuilding plan.
			$CPUE < ¼ CPUE_0$	N/A	Rebuilding plan.
1	Overfishing	F	$F > F_{MSY}$	None.	Reduce F.
	Overfished	B	$B < ½ B_{MSY}$	None.	Rebuilding plan.
2	Overfishing	CPUE	$CPUE < ½ CPUE_0$	N/A	Reduce effort and rebuilding plan.
	Overfished		$CPUE < ¼ CPUE_0$	N/A	

Table 9: Summary of status determination criteria and reference points for Red Crab FMP. "None" indicates that we have not yet identified a suitable proxy for this reference point, and "N/A" indicates that a proxy is not applicable for this reference point.

3.6 Optimum Yield

3.6.1 Overview

National Standards [16 U.S.C. 1851 § 301]:

(1) Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the *optimum yield* from each fishery for the United States fishing industry.

As stated in National Standard 1, the Magnuson-Stevens Act requires that the conservation and management measures contained in an FMP achieve optimum yield (OY) from the fishery on a continuing basis. The Act defines OY as follows:

Definition of Optimum Yield [16 U.S.C. 1802 § 3]:

(28) The term "optimum", with respect to the yield from a fishery, means the amount of fish which --

(A) will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems;

(B) is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and

(C) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.

Although all FMPs must contain conservation and management measures to achieve OY, OY itself is not a limit criteria. Instead of an absolute ceiling, OY is a target reference point that is the desired result of the management plan. Because it is a target, exceeding OY does not necessarily constitute overfishing. This introduces the concept of *targets* as differentiated from limits.

The maximum fishing mortality threshold (MFMT) and the minimum stock size threshold (MSST) are limits. If fishing effort exceeds the MFMT, then overfishing is occurring and management action must be taken. If the biomass of a stock falls below MSST, then the stock is overfished and a rebuilding plan must be implemented. Targets, on the other hand, define where we would like things to be. Thus, the OY target defines how much yield we would like to see the fishery take. There can be fishing effort targets as well as biomass targets. In addition to the specification of OY for the Red Crab FMP, this section will also address targets for the management program and the fishery.

3.6.2 Specification of Optimum Yield

The Council must specify optimum yield (OY) for this fishery in the FMP. As an example of an OY specification for a similar species and similar fishery, the Council reviewed the South Atlantic Council's Golden Crab FMP. In the Golden Crab FMP, OY is specified as follows:

Optimum yield (OY) is all golden crab that are harvested legally under the

provisions of the Golden Crab FMP which is equivalent to that level of golden crab harvest that would minimize user conflict among vessels, minimize the cost of fishing, produce a stable level of landings that would maximize returns to the fishermen, provide for a stable supply, and minimize management costs.

In developing this specification for OY, the South Atlantic Council also considered basing OY on a harvest level which ensures the weight of the spawning stock does not decrease below some minimum threshold percentage of the spawning stock that would occur in an unfished fishery. They also considered setting OY as all golden crab harvested while maintaining the fishing mortality rate equal to some objective level (M, F_{msy}, $F_{0.1}$, or F_{max}), or simply setting OY equal to MSY. All of these alternatives were rejected due to a lack of sufficient information.

While we may not have sufficient information to measure spawning stock biomass (SSB) on a yearly basis (because currently there are no plans for an annual fishery independent survey) or to measure the actual fishing mortality rate, we do have an estimate of MSY. Thus, the Council could specify OY based on MSY. According to part (B) of the Magnuson-Stevens Act definition, OY can be interpreted as follows:

$OY = MSY + (C_{ECON} + C_{SOC} + C_{ECOL})$, if $\Sigma C_n < 0$, or
$OY = MSY$, if $\Sigma C_n > 0$, where
MSY = Maximum sustainable yield;
C_{ECON} = Economic Considerations;
C_{SOC} = Social Considerations;
C_{ECOL} = Ecological Considerations; and
each factor can be either negative (a potential *reduction* from MSY) or positive (a potential *increase* from MSY) but the sum of the factors can only be negative or zero (i.e., OY cannot exceed MSY).

To implement this alternative, we would examine each of these factors in turn and determine whether or not there are any relevant considerations that would warrant an adjustment in the target yield. For example, we could examine the known ecological considerations -- including the relationship of red crab to other species, the importance of red crab as a prey source for other species, the impact of the red crab fishery on important marine habitats, and any impacts of the fishery on bycatch or other targeted species -- and identify any reasons to consider reducing or increasing the target yield to account for these issues. If no concerns are identified, then we could conclude that OY does not need to account for any ecological considerations. We would then repeat this process for social and economic considerations. For any factors for which we should adjust the target yield, we would estimate either a quantity of red crab or a percentage of yield for which we need to account.

We would then sum over the three potential yield adjustment factors and compute the total adjustment to yield required to account for the economic, social or ecological considerations. If this total amount is negative (implying a reduction in yield to account for these factors), then this amount would be specified as the reduction in MSY that would provide us with OY. If the total amount is positive (implying an increase in yield

to account for these factors), then OY will not be adjusted and will simply be equivalent to MSY (this is because, according to the Magnuson-Stevens Act, OY cannot be *more* than MSY). OY would be specified as that amount of red crab harvested in the directed red crab fishery, subject to all the provisions of the Red Crab FMP, that equals MSY as reduced by economic, social, and/or ecological considerations relevant to this fishery. This approach is intended to incorporate changes to MSY to account for any uncertainty about the status or vulnerability of the resource or the current levels of fishing effort.

Ecological considerations: The first factor examined for red crab as an indication of an adjustment to MSY is ecological. The NSGs suggest several considerations, including: stock size and age composition; the vulnerability of incidental or unregulated stocks in a mixed-stock fishery; predator-prey or competitive interactions; and dependence of marine mammals and birds or endangered species on a stock of fish. Because this is not a mixed-stock fishery, that consideration will not be addressed. There are no current data on stock size and very little is known about the age composition of the red crab population. Accordingly, there is no information on this consideration with which to judge whether an adjustment to yield would be appropriate. Since the adjustment could be positive or negative, assuming a zero adjustment appears justified.

As reported in Steimle et al. (2001), there is little indication that red crab constitute a major prey item for any species. There are few records of predation on red crabs, but these appear only as minor components of prey sources (Steimle et al. 2001). There are few records of red crab prey sources. Gray (1969) and Beyers et al. (1980) both report some observations and suggest a variety of food sources for red crabs. Sea anemones may be a desired prey (Gray 1969), but most likely red crabs are opportunistic omnivores due to the limited availability of food at the water depths common for red crabs (Beyers et al. 1980; Steimle et al. 2001). Based on what is known about red crab predator-prey interactions, no adjustment to yield for this factor appears warranted. Also, although Steimle et al. (2001) describes a few competitive interactions (primarily with Jonah crab, *Cancer borealis*, American lobster, *Homarus americanus*, and golden crab, *Chaceon fenneri*), none of these appears significant enough to warrant an adjustment to yield.

The last ecological consideration identified in the NSGs suggests dependence of any marine mammals, birds, or endangered species. There is no information in any of the available literature reviewed for this FMP that suggests red crabs are a significant, or even a minor, component of the diets of any marine mammals, birds, or endangered species. Overall, it appears that there are no ecological reasons to suggest an adjustment to yield either above or below what would otherwise be the optimum yield.

Social considerations. The second factor examined for red crab as an indication of an adjustment to MSY is social. The NSGs suggest several considerations, including: enjoyment gained from recreational fishing; avoidance of gear conflicts and resolving disputes; preservation of a way of life for fishermen and their families; and dependence of local communities on a fishery. Due to the depths and distances from shore required to fish for red crabs, there are no known recreational fishing activities targeting this species. Also, due to the depths and distances from shore at which the commercial fishery takes place, the potential for gear conflicts or other disputes with other fisheries is

minimized. In fact, the Council is unaware of any direct gear conflicts or other disputes between the red crab fishery and any other commercial or recreational fishery.

Preservation of a way of life for fishermen and their families is always an important consideration in the development of an FMP, but this fishery has always been limited to a few fishing vessels and fishermen. Only in the past year has the interest and involvement of fishermen in the red crab fishery grown in response to changing economic conditions and the availability of substitute resources. Thus, any management program developed by the Council which either directly or indirectly protects those fishermen traditionally involved in the red crab fishery would satisfy this condition without the need to adjust the target yield. Because of the small and dispersed nature of this fishery, there are no communities dependent upon the red crab fishery (see Section 8.4.5).

Economic considerations. The third and final factor examined for red crab as an indication of an adjustment to MSY is economic. The NSGs suggest several economic considerations, including: the risk of overharvesting when a stock's size or productive capacity is uncertain; satisfaction of consumer and recreational needs; and development of domestic and export markets for U.S.-harvested fish. Although there is always a risk of overharvesting when management operates with imperfect information, and the current size of the stock is unknown, the productive capacity (MSY) of the resource is known (Serchuk 1977). As stated above, there are no known recreational fishing activities affected by the commercial red crab fishery and consumer needs appear to be satisfied under current conditions of the fishery. It is an objective of the FMP to ensure the continued and consistent harvest and supply of consumer products from this fishery. Lastly, both U.S. and foreign markets appear to exist for the products of this fishery and these opportunities do not appear to be threatened by the current estimates of annual target yield for the fishery.

Another economic consideration which should be factored into the setting of a target yield under this alternative is the difference between MSY and MEY. MEY will always be less than MSY (see the description of Alternative 2 for an explanation). Assuming the MEY estimated for the previous alternative (MEY = 95% of MSY), the difference between MSY and MEY is a valid factor on the consideration of OY. Thus, to address economic considerations, and in the absence of any other economic factors, MSY should be reduced by 5%.

Adjustment to MSY. The 5% reduction to MSY suggested above should account for current uncertainties about the status of the resource, its vulnerability to overfishing, and the levels of fishing effort in the fishery. Returning to the original equation suggested as the basis for this alternative, we use:

MSY (Maximum sustainable yield) = 6.24 million pounds
C_{ECON} (Economic Considerations) = -5% of MSY
C_{SOC} (Social Considerations) = 0
C_{ECOL} (Ecological Considerations) = 0
OY = 6,240,000 + (-312,000 + 0 + 0)
OY = 5,928,000 pounds

3.6.3 Non-Preferred Alternatives

3.6.3.1 Non-Preferred Alternative 1: OY = MSY

The first alternative is a very straightforward application of the statutory limit of OY, and would specify that OY is simply set equal to the best available estimate of MSY for the red crab resource.

This alternative is supportable in that we have an estimate of MSY for this resource, but it is not supported by the definition of OY in the Magnuson-Stevens Act or the further guidance provided in the national standard guidelines (NSGs). OY is intended to represent the amount of yield that best optimizes biological, economic, social, and ecological factors. This alternative only recognizes the biological factors and sets OY equal to the theoretical biological limit for a sustainable fishery, MSY. Economic, social, and ecological factors are not incorporated into this alternative.

3.6.3.2 Non-Preferred Alternative 2: OY = 90% of MSY

This alternative would specify that OY is set equal to the best available estimate of MSY, conservatively reduced by 10% to account for potential economic, social and ecological concerns.

This alternative begins with the theoretical biologic limit for a sustainable fishery, MSY, and, reduces this yield by some amount to account for other non-biological factors. The use of 10% is intended to represent a precautionary approach that should account for these factors without the necessity of quantifying them.

Because so much is unknown about this resource and its fishery, quantitatively specifying proposed adjustments to MSY to account for economic, social, and ecological factors may not be possible at this time. The NSGs suggest that the "Councils should adopt a precautionary approach to specification of OY" (63 FR 24212). Although there are many interpretations of the phrase "precautionary approach" it is essentially a proactive management tenet that urges conservation in the face of scientific uncertainty.

In this application, a lack of scientific certainty on the quantitative amounts that the overall yield should be adjusted to completely account for economic, social, and ecological considerations should not prevent the Council from reducing MSY by some amount. This amount (the 10% reduction suggested in this alternative) is simply an estimate of the amount of yield most likely to fulfill the requirements of the Magnuson-Stevens Act. Although a 10% reduction is somewhat arbitrary, the Council feels that this amount best represents the intent of the NSGs, as explained in the context of a precautionary approach by Restrepo et al. (1998).

3.6.3.3 Non-Preferred Alternative 3: OY = MEY (95% of MSY)

This alternative would specify that OY is set equal to the maximum economic yield (MEY) to account for economic considerations.

In theory, MEY is defined as the point at which profits to the fishery are maximized[10] over time and effort is at the least cost level. MEY occurs at the point where the marginal benefit of effort is equal to the marginal cost of effort. Net benefits for consumers and the seafood sector of the economy could also be included if prices change with landings.

This alternative seeks to recognize the economic aspect of maximizing yield in a fishery and incorporate, if not the social and ecological considerations of OY, the economic considerations. The difficulty with this alternatives lies in the estimation of MEY. In order to estimate the level of effort and landings equivalent to MEY, we need a bioeconomic model that incorporates the influence of fishing effort on sustainable levels of production. Unfortunately, due to the lack of recent information on red crab biology, we cannot estimate the amount of yield that can be sustained over time, for a given amount of fishing effort. A simple Schaefer-type logistic growth model may be acceptable when exploitation rates are low, but can produce errors when extended to higher rates or unknown levels of exploitation. Many alternatives to the logistic growth models have been proposed to describe fish populations, but in this case it is impossible to accurately estimate one.

Since MEY cannot be estimated, setting MEY = 95% of MSY provides a less conservative alternative than Alternative 2, but still has some reduction to account for potential economic concerns.

3.6.3.4 Comparison of OY Alternatives

The following table summarizes the four alternatives for the specification of optimum yield for the Red Crab FMP.

	Calculation of OY	MSY	OY
Preferred Alternative	OY = MSY + (C_{ECON} + C_{SOC} + C_{ECOL})	6.24 M pounds	5.928 M pounds
Alternative 1	OY = MSY	6.24 M pounds	6.24 M pounds
Alternative 2	OY = 90% * MSY	6.24 M pounds	5.616 M pounds
Alternative 3	OY = MEY	6.24 M pounds	5.928 M pounds

Table 10: Summary of alternatives for OY, assuming a value of MSY = 6.24 million pounds (based on the discussion in Section 3.4.3). As MSY is adjusted to account for other factors (commercial size of crab, extent of management unit, natural mortality), so to should the specifications of OY under each alternative.

[10] While the profits of individual fishermen or entities may vary, fisheries economics is concerned primarily with the behavior, costs, and benefits of the fishery as a whole. Thus, while MEY may not represent the point at which all of the fishermen or fishing entities maximize their individual profits, it does represent the idealized point at which the fishery's profits are maximized.

3.6.4 Targets

The guidelines for National Standard 1 state that "target reference points, such as OY, should be set safely below limit reference points." There are two main types of target reference points: a target fishing mortality rate or other indication of fishing effort; and a target stock biomass. These targets provide goals for the management program rather than constraints as are established with the limit reference points.

In the Red Crab FMP, the limit reference points will be determined by the selection of an appropriate overfishing definition. The targets, on the other hand, are largely determined by the selection of an appropriate OY. The alternatives described above suggest four varied approaches for OY. Each of these, in turn, serves as an alternative target level of fishing effort.

Since we are currently unable to determine or estimate fishing mortality rates, a more direct approach such as monitoring of fishing effort is required. At a minimum, the Council will closely monitor landings of red crab as an indicator of relative fishing effort and a proxy for the actual fishing mortality rate. The target reference point for fishing effort will be a proxy for OY, as expressed in pounds of marketable red crabs landed by the directed red crab fishery.

In addition to a target for fishing effort (or, in this case, annual yield), we can also develop a target for stock biomass. Since all of the alternatives for OY (and subsequently the target levels of fishing effort as expressed in terms of annual yield) are set at or below MSY, a target biomass equal to B_{msy} would ensure a stock biomass capable of producing OY on a continuing basis. Thus, under all OY alternatives, the target biomass for the red crab stock will be B_{msy} (male-only) = 26.5 to 41.6 million pounds, depending on the accepted minimum size and the southern extent of the management unit.[11] Based on the factors described in Section 3.4, the target biomass consistent with the calculation of an MSY of 6.24 million pounds is B_{msy} = 41.6 million pounds.

3.7 Essential Fish Habitat

3.7.1 Background

3.7.1.1 Legal Authority and Mandate

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act, known as the Sustainable Fisheries Act (SFA), expanded the focus of the Magnuson-Stevens Act by emphasizing the importance of habitat protection to healthy fisheries and by strengthening the ability of the National Marine Fisheries Service (NMFS) and the Councils to protect and conserve the habitat of marine, estuarine, and

[11] Typically, for populations with logistic growth, B_{msy} is assumed to equal to ½ the virgin biomass, B_o. For red crab, based on the adjustments made to the results of the Wigley et al. (1975) survey, B_o (male-only) is estimated to be between 52.8 and 83.2 million pounds. Thus, B_{msy} (male-only) would be between 26.4 and 41.6 million pounds.

anadromous finfish, mollusks, and crustaceans. This habitat is termed "essential fish habitat" and is broadly defined to include "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity."

To improve fish habitat protection, the Magnuson-Stevens Act now requires the Councils, NMFS, and other federal agencies to take specific new actions. The Magnuson-Stevens Act now requires the Council, after receiving recommendations from NMFS, to complete the following for all new FMPs or FMP amendments:

EFH Designation Mandate [16 U.S.C. 1853 § 303]:

(a) Any fishery management plan which is prepared by any Council . . . shall --

(7) describe and identify essential fish habitat for the fishery based on the guidelines established by the Secretary, minimize to the extent practicable adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat;

The Magnuson-Stevens Act also now requires all Federal agencies (and other entities funded by Federal sources) engaging in activities that may adversely affect EFH to consult with NMFS regarding those activities. NMFS and the Councils may make suggestions on how to mitigate any potential habitat damage. Once these agencies receive NMFS' comments, they must respond in writing within 30 days, outlining the measures they are proposing to mitigate the impact of the activity on EFH. They must also explain any inconsistencies between the mitigation actions they propose with the recommendations made by NMFS. This is known as the "EFH Consultation Process" and is required and authorized under 16 U.S.C. 1853 § 305 and states:

EFH Consultation Mandate [16 U.S.C. 1853 § 305]:

(2) Each Federal agency shall consult with the Secretary with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any essential fish habitat identified under this Act.

(3) Each Council --

(A) may comment on and make recommendations to the Secretary and any Federal or State agency concerning any activity authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by any Federal or State agency that, in the view of the Council, may affect the habitat, including essential fish habitat, of a fishery resource under its authority; and

(B) shall comment on and make recommendations to the Secretary and any Federal or State agency concerning such activity that, in the view of the Council, is likely to substantially affect the habitat, including essential fish habitat, of an anadromous fishery resource under its authority.

3.7.1.2 History

The Magnuson-Stevens Act required the Council to amend its existing FMPs to address the EFH provisions and submit these amendments to the Secretary of Commerce

no later than October 11, 1998. To meet this requirement, the Council had to identify and describe essential fish habitat for 18 Council-managed species (sea scallops, monkfish, Atlantic herring, Atlantic salmon, and 14 species of groundfish), identify and, to the extent practicable, take action to minimize fishing-related adverse effects on EFH, identify and propose measures to conserve and enhance EFH, and identify habitat-related research and information needs.

The Council developed a single, stand-alone FMP amendment that addressed the EFH requirements of all 18 Council-managed species. This document, the "omnibus" EFH amendment, was submitted to NMFS on October 7, 1998. Following review by NMFS, the sea scallop, groundfish, and Atlantic salmon portions of the amendment were approved by the Secretary on March 3, 1999. The monkfish portions were approved on April 22, 1999. The portions of the amendment related specifically to Atlantic herring were approved with the Herring FMP. Amendment 12 to the Northeast Multispecies (Groundfish) FMP extended Council management to offshore hake, and included the required EFH designations and review for this species.

Since fishery management plans have been amended with EFH information, NMFS and the Councils are more proactive in protecting habitat areas by alerting other federal and state agencies about areas of concern, and urging them to avoid planning projects that might cause adverse impacts to EFH in these areas. When projects are planned that may adversely affect EFH, the Councils and NMFS can recommend conservation measures.

3.7.1.3 Definitions

The Magnuson-Stevens Act defines essential fish habitat as follows:

Definition of EFH: [16 U.S.C. 1802 § 3]
(10) The term "essential fish habitat" means those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.

For the purposes of interpreting this definition, "waters" includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include aquatic areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (67 FR 2343).

Fish habitat is where a species is found during some or all of its life. Fish habitat is used here both in the traditional sense where structure or substrate delineates its geographic boundaries (e.g., coral reefs, marshes, and kelp beds) and in the less conventional sense where boundaries are more fluid (e.g., turbidity zones, thermoclines, and fronts separating water masses). Historical fish habitat is the geographic area where a species was found at some point in time; this habitat may not be used now if the species distribution has changed or has been reduced, or access has been altered by man or natural events. Fish use habitat for spawning, breeding, migration, feeding and growth,

and for shelter to reduce mortality. Most habitats provide only a subset of these functions. Fish habitat can change with life stage, abundance, the presence of other species, and with temporal and spatial variability in the environment. The type of habitat available, its attributes, and its functions are important to the productivity of a species.

3.7.1.4 Guidelines

On January 17, 2002, NMFS published the Final Rule (67 FR 2343) on essential fish habitat. This rule established guidelines to assist the Councils and the Secretary of Commerce in the implementation of the EFH provisions of the Magnuson-Stevens Act, including the description and identification of EFH in fishery management plans (FMPs), the identification of adverse impacts from both fishing and non-fishing activities on EFH, and identification of actions required to conserve and enhance EFH. The regulations also detailed procedures the Secretary (acting through NMFS), other Federal agencies, state agencies, and the Councils will use to coordinate, consult, or provide recommendations on Federal and state activities that may adversely affect EFH.

According to the NMFS EFH Guidelines, EFH must be designated according to the level of information available on the species distribution, abundance, and habitat-productivity relationships. The levels of information, as defined in the Final Rule, are:

- Level 1: Distribution data are available for some or all portions of the geographic range of the species. At this level, only distribution data are available to describe the geographic range of a species (or life stage). Distribution data may be derived from systematic presence/absence sampling and/or may include information on species and life stages collected opportunistically. In the event that distribution data are available only for portions of the geographic area occupied by a particular life stage of a species, habitat use can be inferred on the basis of distributions among habitats where the species has been found and on information about its habitat requirements and behavior. Habitat use may also be inferred, if appropriate, based on information on a similar species or another life stage.

- Level 2: Habitat-related densities of the species are available. At this level, quantitative data (i.e., density or relative abundance) are available for the habitats occupied by a species or life stage. Because the efficiency of sampling methods is often affected by habitat characteristics, strict quality assurance criteria should be used to ensure that density estimates are comparable among methods and habitats. Density data should reflect habitat utilization, and the degree that a habitat is utilized is assumed to be indicative of habitat value. When assessing habitat value on the basis of fish densities in this manner, temporal changes in habitat availability and utilization should be considered.

- Level 3: Growth, reproduction, or survival rates within habitats are available. At this level, data are available on habitat-related growth, reproduction, and/or survival by life stage. The habitats contributing the most to productivity should be those that support the highest growth, reproduction, and survival of the species (or life stage).

- Level 4: Production rates by habitat are available. At this level, data are available that directly relate the production rates of a species or life stage to habitat type, quantity, quality, and location. Essential habitats are those necessary to maintain fish production consistent with a sustainable fishery and the managed species' contribution to a healthy ecosystem.

3.7.2 Identification and Description of EFH for Red Crab

The regulatory text of the Final Rule (67 FR 2343) directs the Council to describe EFH in text that provides information on the biological requirements for each life history stage of the species. Tables are provided in individual species reports and summarize all available information on environmental and habitat variables that control or limit distribution, abundance, reproduction, growth, survival, and productivity of the managed species.

The regulatory text of the Final Rule also directs the Council to present the general distribution and geographic limits of EFH for each life history stage in the form of maps. These maps are presented as fixed in space and time, but they encompass all appropriate known temporal and spatial variability in the distribution of EFH. The EFH maps are a means to visually present the EFH described in the amendment.

There are two distinct but related components of the process to comply with the guidelines of the Final Rule: (1) developing the text description of essential fish habitat; and (2) identifying the geographic extent of essential fish habitat. Together, they provide a picture of the EFH for Council-managed species.

To support the Council, NMFS develops individual species reports for most species managed by the Council. These reports consist of literature reviews documenting the life history and habitat requirements of the species, as well as food habits information and distribution and abundance information by life history stage. The species report for deep-sea red crab was developed by NMFS and is provided in Appendix A. The information presented in the species report was used to develop the EFH text description.

The text descriptions of essential fish habitat define the environmental parameters within the areas represented by the map designations. NMFS regulations within the Final Rule require that the text description take precedence when the text and EFH maps differ. These text descriptions identify the habitat requirements for each species by life history stage. They include the general geographic area(s) preferred by the species, the preferred substrate (if demersal), and ideal ranges of water temperature, depth, and salinity (where known). The descriptions reflect the best available information on the species' habitat requirements collected from the scientific literature and observations made during research surveys. Because this species occurs only offshore in deep water, sources of information on inshore areas (e.g., NOAA's Estuarine Living Marine Resources Program reports) were not considered.

There are two parts to every EFH designation. The first part of the EFH designation for each species includes a text-based description of the habitat

characteristics considered essential for that species at each major life history stage. The text descriptions include physical as well as oceanographic parameters. The second part of the EFH designation for each species includes a set of maps indicating the geographical extent of the EFH designation and the range of the species. A unique map is created for each major life history stage. The intent of the two-part EFH designation is for the map to indicate the geographical extent within which the text description applies. Thus, if the map indicates that eastern Georges Bank was EFH for a particular species and the text description indicates that sandy habitats within a depth range of 50 - 100 meters was EFH, then only those portions of eastern Georges Bank that met the physical characteristics would actually be considered EFH.

3.7.3 EFH Designation Methodology

The Council considered a range of alternatives for methods and approaches that could be adopted to identify and describe essential fish habitat for deep-sea red crab. The alternatives presented offer options for how best to determine the areal extent within which the EFH Text Description would apply.

3.7.3.1 Preferred EFH Designation Methodology Alternative

The general distribution of this species has been suggested as tightly correlated to depth along the U.S. continental slope (Wigley et al. 1975; Steimle et al. 2001). Members of the fishing industry report using depth as the primary indicator for where to fish for red crabs (J. Williams, personal communication). There are several scientific papers which discuss and identify depth ranges used by this species both as adults and as juveniles (Wigley et al. 1975; Steimle et al. 2001). Thus, it may be appropriate to use the known depth range affinities of this species as indicators of the extent of essential fish habitat.

For example, in Steimle et al. (2001), the full depth range for juvenile red crabs is indicated as 700 - 1800 meters and the full depth range for adult red crabs is indicated as 200 - 1300 meters. Wigley et al. (1975) support these ranges but also indicate that adults are most abundant between 320 - 914 meters. The full range of the species would be represented by the union of the juvenile and adult depth ranges, or 200 - 1800 meters. The maps in Figure 18 - Figure 21 reflect these depth ranges.

For most life stages, there are at least two options for an appropriate depth range for the EFH designation. For example, juvenile EFH could be designated based on the full depth range occupied by the species, or it could be based on the known depth range for juveniles. Adult EFH could be designated based on the full depth range occupied by the species, the full known depth range for adults, or a more narrow depth band known to contain much higher concentrations of red crab adults. It is a little more complicated for eggs and larvae. Eggs remain attached to adult female red crabs for the duration of this life stage, so there may be no need to designate EFH for red crab eggs. Larvae are the only pelagic life stage for this species, and very little is known about their movement, behavior, and range.

Red crab larvae may cover great distances while pelagic, settling by chance in suitable habitat or they may remain resident in the general area and settle out quickly once they reach the appropriate depths. Because so little is known about this life stage, it is difficult to precisely delineate the essential fish habitat for red crab larvae. In similar situations with other species for which there was very little or no information available on the egg and/or larval life stages, the Council assumed that the union of the adult and the juvenile ranges would serve as an acceptable proxy for the unknown life stage(s). The same can be done for red crab, using the depth range of 200 - 1800 meters as a proxy for the range of optimal larval habitat.

3.7.3.2 Non-Preferred EFH Designation Alternatives

a. Non-Preferred Alternative 1 -- No EFH Designation

Considered the "no action" alternative, this approach would result in there being no EFH designated for red crab. According to the 1996 amendments to the Magnuson-Stevens Act, however, the Regional Fishery Management Councils are mandated to designate EFH for each species managed under an FMP. Thus, this alternative would not be in compliance with the Magnuson-Stevens Act. According to the National Environmental Policy Act (NEPA), the full range of alternatives considered in a proposed action should include the no action alternative. Consideration of this alternative fulfills the requirements and intentions of NEPA. Because selection of this alternative would result in the Red Crab FMP being out of compliance with the Magnuson-Stevens Act, this alternative is not suitable for selection. There would be no EFH Text Description for this alternative.

b. Non-Preferred Alternative 2 -- NMFS Survey Data

In the Council's previous EFH designations (NEFMC 1998), the areal extent of the EFH designations, as reflected in the EFH maps, were based upon an index of catch-per-unit-effort (CPUE) data resulting from the NMFS' Bottom Trawl and MARMAP Ichthyoplankton surveys. All survey catches, on a per tow basis, were binned and averaged for each ten minute square of latitude and longitude. The averaged catch-per-tow data were then ranked from highest average catch-per-tow (per ten minute square) to lowest positive average catch-per-tow. Starting with the ten minute square with the highest average catch-per-tow, the averages for each ten minute square were summed and the cumulative percentage of the total average catch-per-tow was calculated.

The ten minute squares were then categorized, using the cumulative percentages, into 50%, 75%, 90% and 100% groups. The 50% category represented the top two quartiles of ten minute squares, the 75% category the top three quartiles, the 90% the top nine deciles and the 100% category represented the full geographic range of the species within the survey. Because these categories reflect an index of catch, not area, the areal percentage of the range of the species is always less. For example, the 50% category of ten minute square includes the top two quartiles of catches and because the species is therefore more abundant (or concentrated) in these ten minute squares, there will be fewer ten minute squares in this category than in the bottom two quartiles. Thus, the 50%

category might only represent 25-30% of the overall range of the species. The percentages selected as the basis for the EFH designation were determined on a species by species basis.

This approach was developed based on the available data (from the NMFS surveys) and is consistent with the regulations and technical guidance developed by NMFS on how to designate EFH based on the level of information available. NMFS described four levels of information to be used, from basic presence/absence data (Level 1) to habitat-specific production data (Level 4). The availability of relative abundance data from the NMFS surveys provided what were considered Level 2 data for most species managed by the New England Council. As such, the regulations and technical guidance indicated use of relative abundance data to differentiate areas with relatively greater abundance of a species as EFH in contrast to areas with relatively lower abundance. Ecologically, it follows that one can infer that areas of relatively high abundance or density are indicative of more suitable habitats. Research has demonstrated that as populations decline, their range contracts and they focus in on areas of best suited habitat.

The EFH designations included in the omnibus EFH Amendment also utilized a variety of other information considered important in the identification and description of EFH. Because the NMFS surveys focus on offshore waters, several sources of information were needed to identify important areas in inshore areas. One such source of information was the Massachusetts Inshore Trawl Survey. Data from the Connecticut Long Island Sound Survey were also used in some cases. The NOAA Estuarine Living Marine Resources Program (ELMR) provided information on the presence/absence of many Council-managed species in a number of estuaries and embayments along the coast of New England and the Mid-Atlantic. Historical information was also used in some cases, as was information provided by members of the fishing industry.

Unlike most other species managed by the New England Council, red crabs are sampled in the NMFS surveys only rarely (Steimle et al. 2001). The survey only extends to 366 meters in depths (Reid et al. 1999), but the species is known to occur out to 1800 meters, with highest densities occurring between 320 and 910 meters in depth (Wigley et al. 1975). Although some red crabs are caught in the survey (Steimle et al. 2001), they are very few in numbers and probably only represent the shallow fringe of their population. Due to the deep-water nature of the species, red crabs are not captured in any of the nearshore surveys, such as the Massachusetts Inshore Trawl Survey or the Connecticut Long Island Sound Survey, nor are they included in the NOAA ELMR information. The survey data, therefore, provide an insufficient basis to accurately designate EFH in the traditional method (for the New England Council). This option is presented for consideration primarily as a basis for comparison with other alternatives that may provide a more robust approach to accurately represent the marine areas important to this species.

c. Non-Preferred Alternative 3 -- Depth Zones plus Sediment Affinities

A slight variation of the previous alternative would be to incorporate any known sediment type affinities of red crabs into the delineation of essential fish habitat for this

species. In addition to mapping the depth zones used by this species, we could overlay the depth zones with sediment maps (Poppe et al. 1989) to further delineate EFH based on habitat descriptions for this species available in the literature. Wigley et al. (1975) and Steimle et al. (2001) both describe some of the primary sediment types in which red crabs appear to occur most frequently.

There are some limitations and weaknesses with this approach, as it assumes that the sediment basemap used to determine areas of EFH is complete and accurate. The best available source of information on the distribution of surficial sediments at the scale appropriate for this task is the map generated by Poppe et al. (1989). This map characterizes the sediment types for the Gulf of Maine, Georges Bank, southern New England shelf, and the Mid-Atlantic Bight, including much of the associated continental slope. Even so, the distribution of sediment types is poorly known and is not adequate for designating EFH in many areas of the Gulf of Maine and southern New England shelf. EFH designated on our current knowledge of sediment distribution would be unreliable and subject to missing many important areas of habitat. Also, this approach may be somewhat redundant with the approach already employed, which is to use the map designations as the areal extent within which the EFH text descriptions apply. If the text descriptions specify the sediment types utilized most often by the species (as they do in all cases where possible), then the combination of the text description and the map designation already includes this sediment-based provision.

d. Non-Preferred Alternative 4 -- EFH is Everywhere

At the other end of the extreme from Alternative 1, this alternative would result in all waters from the shoreline to the EEZ designated as EFH for this species, whether red crabs occur in all areas or not. This alternative would indicate the most broad EFH designations possible. If all waters out to the EEZ are EFH for this species, then there is no possibility that the EFH designation would miss any important areas (within U.S. waters). However, this approach is not consistent with the intentions of the Magnuson-Stevens Act, which suggests that EFH should be a subset of all habitat available to a species. The NMFS regulations and technical guidance specify that EFH should be designated within the full range of each species. This approach would actually go beyond this intention and include areas outside of the species' range as EFH.

3.7.4 EFH Text Description and Maps of EFH

3.7.4.1 EFH Text Description

In its *Report to Congress: Status of the Fisheries of the United States* (January 2001), NMFS reported that the status of the resource is currently unknown. EFH for red crab includes those areas of the offshore waters (out to the offshore U.S. boundary of the exclusive economic zone) that are identified on the following figures and described by the following conditions. The text description refers to the maps of the preferred options for EFH designation for each life history stage. If the Council's preferred options change, the EFH text description will be modified to reflect these changes.

Eggs: Red crab eggs are brooded attached to the underside of the female crab until they hatch into larvae and are released into the water column. Egg-bearing females are most commonly found on the shallow continental slope between 200 and 400 meters, where temperatures are typically between 4 - 10° C. The EFH designation for red crab eggs will be the same as the known distribution of egg-bearing females (200 - 400 meters) along the southern flank of Georges Bank and south to Cape Hatteras, North Carolina, as depicted in Figure 5.

Larvae: Essential fish habitat for red crab larvae is described as the water column from the surface to the seafloor across the entire depth range identified for the species, 200 - 1800 meters along the southern flank of Georges Bank and south to Cape Hatteras, North Carolina, as depicted in Figure 6. Generally, the following conditions exist where red crab larvae are most commonly observed: water temperatures between 4 and 25° C, salinities between 29 and 36‰, and dissolved oxygen between 5 and 8 ml/l. Red crab larvae appear to be most common during January through June.

Juveniles: Bottom habitats of the continental slope with a substrate of silts, clays, and all silt-clay-sand composites within the depths of 700 to 1800 meters along the southern flank of Georges Bank and south to Cape Hatteras, North Carolina, as depicted in Figure 7. Generally, the following conditions exist where red crab juveniles are most commonly observed: water temperatures between 4 and 10° C, salinities of approximately 35‰, and dissolved oxygen between 3 and 7 ml/l.

Adults: Bottom habitats of the continental slope with a substrate of silts, clays, and all silt-clay-sand composites within the depths of 200 to 1300 meters along the southern flank of Georges Bank and south to Cape Hatteras, North Carolina, as depicted in Figure 8. Generally, the following conditions exist where red crab adults are most commonly observed: water temperatures between 5 and 14° C, salinities of approximately 35‰, and dissolved oxygen between 3 and 8 ml/l.

Spawning Adults: Bottom habitats of the continental slope with a substrate of silts, clays, and all silt-clay-sand composites within the depths of 200 to 1300 meters along the southern flank of Georges Bank and south to Cape Hatteras, North Carolina, as depicted in Figure 8. Generally, the following conditions exist where red crab adults are most commonly observed: water temperatures between 4 and 12° C, salinities of approximately 35‰, and dissolved oxygen between 3 and 8 ml/l.

A table presenting summary information on the habitat affinities and requirements for each life history stage of red crab is provided in Appendix A, the EFH Source Document. There is no information on the existence or occurrence of deep-sea red crab in any bays or estuaries of the northeastern U.S. The Council acknowledges that there may be potential seasonal and spatial variability of the environmental conditions generally associated with this species.

3.7.4.2 Maps of EFH Designation Options

The following set of maps (Figure 5 - Figure 8) represents the mapping components of the EFH designations for each major life history stage (eggs, larvae, juveniles, and adults) of red crab. Although deep-sea red crabs occur elsewhere in the ocean (in the Gulf of Maine, on the Canadian side of the Hague Line, and south of Cape Hatteras, North Carolina), these areas are not proposed as EFH for red crabs. The abundance of red crabs in the Gulf of Maine is not considered high enough to support a fishery and all of the current and historic fishing effort has been located along the continental slope from the southern side of Georges Bank south to Norfolk Canyon. The EFH regulations require that EFH be designated only in U.S. waters, so while there may be important red crab habitat along the southern flank of Georges Bank on the Canadian side of the Hague Line, this area will not be considered for EFH designation. Also, EFH for this species will not be designated outside the boundary of the management unit, Cape Hatteras, North Carolina. Following the four maps identifying EFH for the four major life stages, there are several maps representing the non-preferred options considered by the Council (Figure 9 - Figure 13).

Essential Fish Habitat
Egg Life Stage

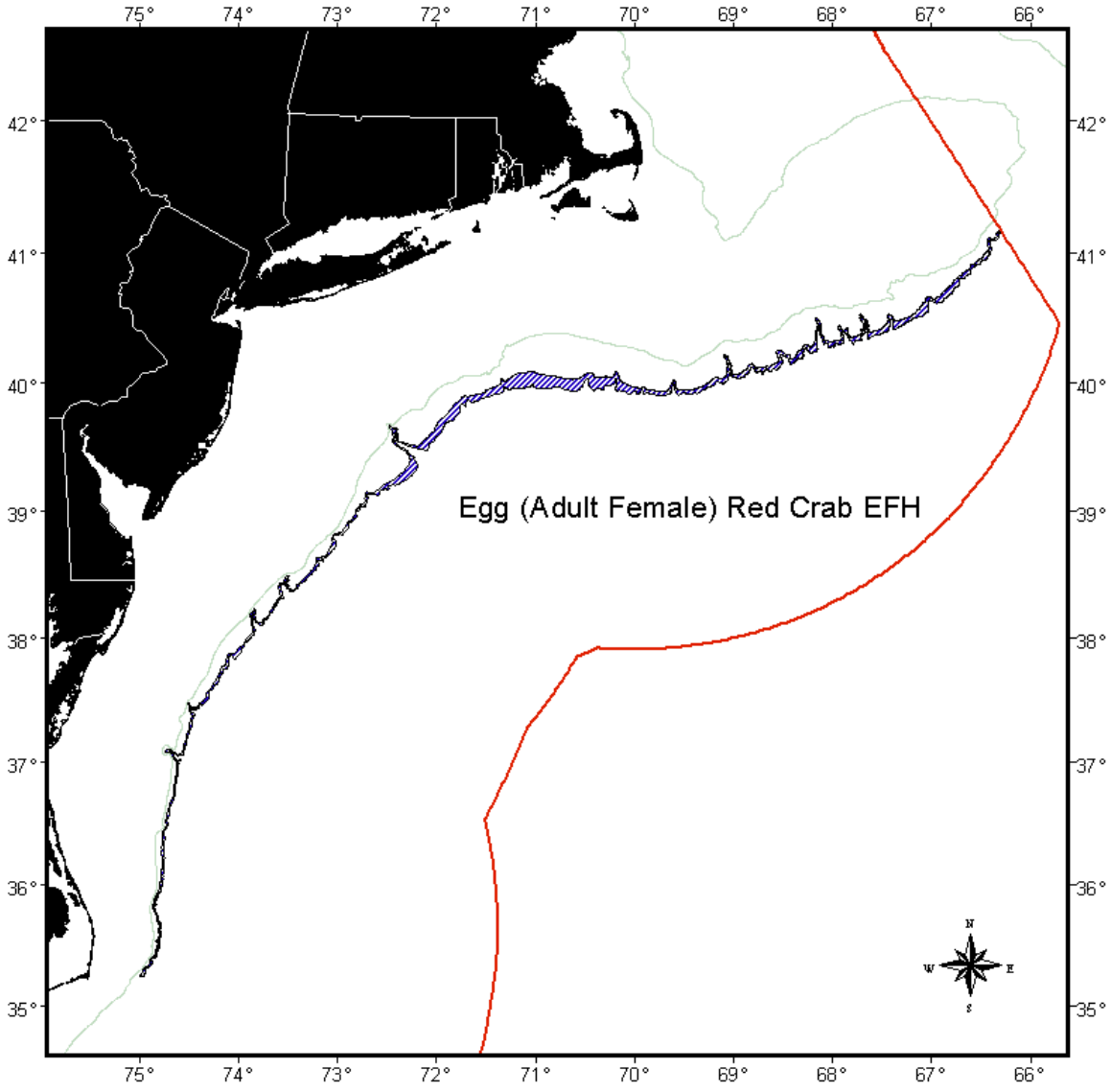

Figure 5: Egg life stage EFH. This map represents the designation of EFH for this life history stage based on known depth zone affinities. This delineates the potential EFH for red crab eggs based on the preferred depth range of adult females (Steimle et al. 2001). This is distinct from the EFH designation for red crab adults, which is much broader to reflect the inclusion of adult males.

Essential Fish Habitat
Larvae Life Stage

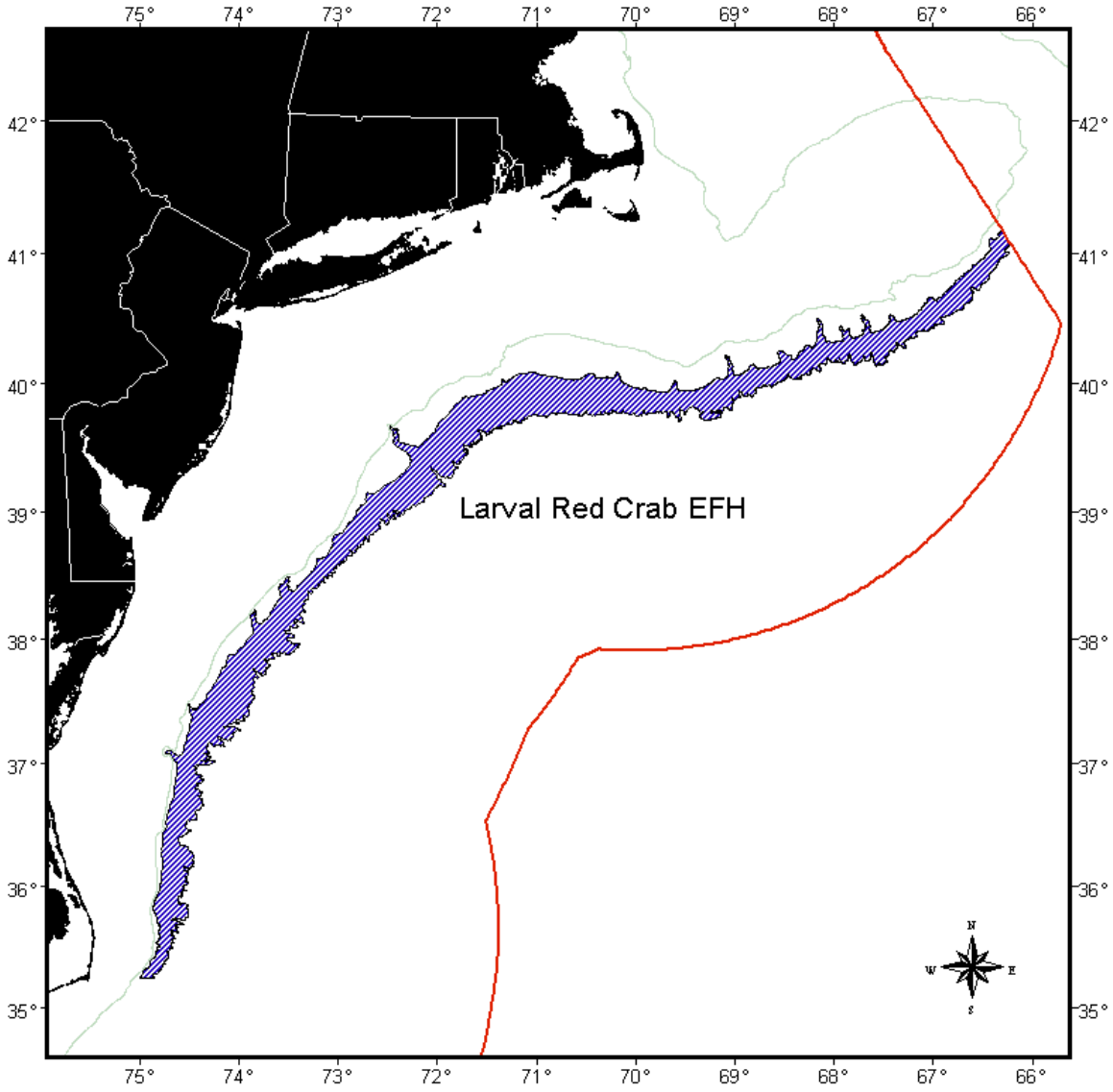

Figure 6: Larval life stage EFH. This map represents the designation of EFH for this life history stage based on known depth zone affinities. This provides the broadest possible delineation based on known depth ranges by utilizing the union of the full adult and juvenile depth ranges, 200 - 1800 meters (Steimle et al. 2001). The union of the juvenile and adult depth ranges is meant to serve as a proxy for the actual range of red crab larvae, which is unknown. This map represents the total area within the preferred depth range for adults and juveniles of this species and thus representative of the area of the water column where red crab larvae are most likely to be found.

Essential Fish Habitat
Juvenile Life Stage

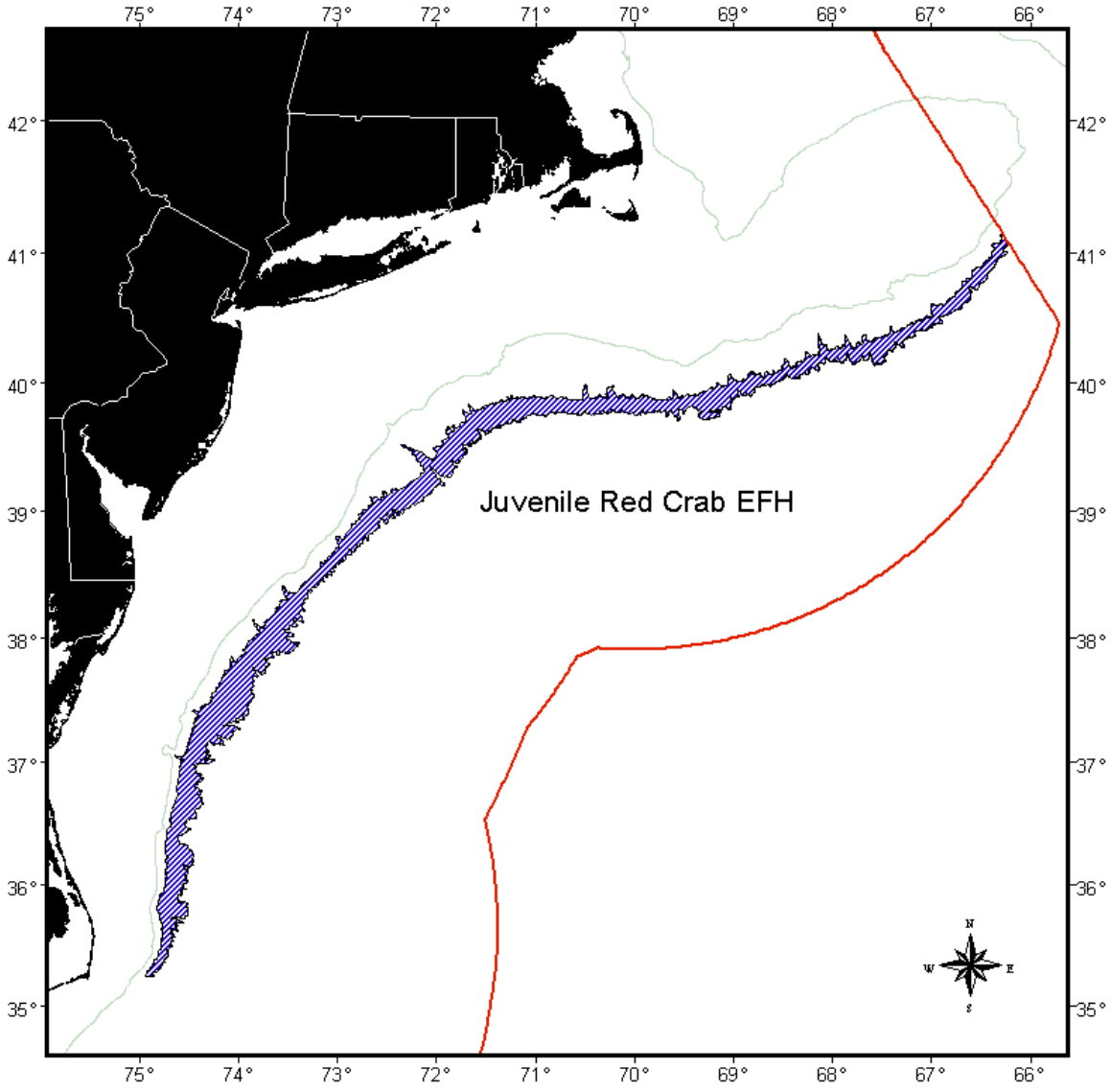

Figure 7: Juvenile life stage EFH. This map represents the designation of EFH for this life history stage based on known depth zone affinities. This includes the total area known to be within the preferred depth range for juveniles of this species. The depth range presented is 700 - 1800 meters (Steimle et al. 2001).

Essential Fish Habitat
Adult Life Stage

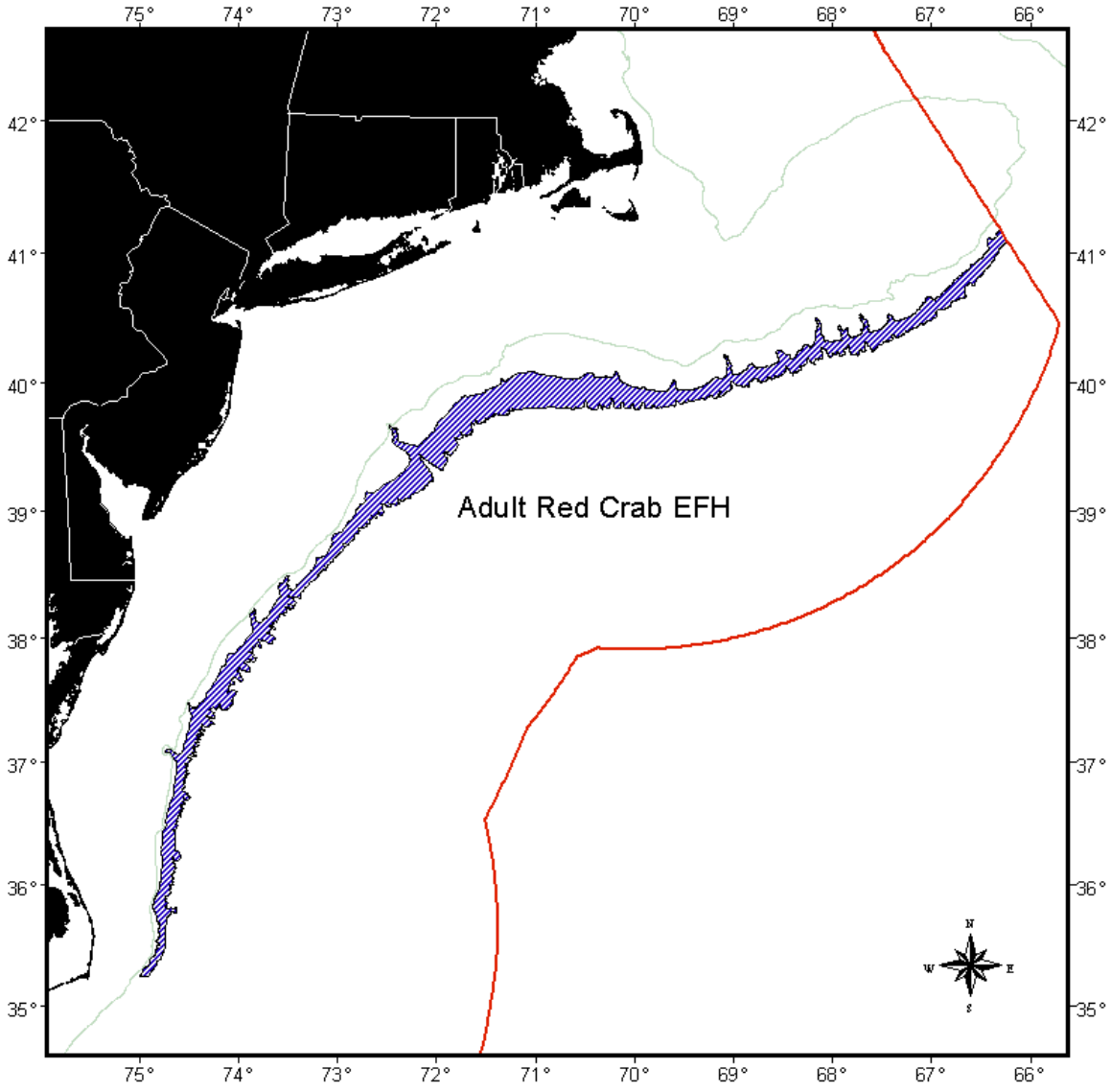

Figure 8: Adult life stage EFH. This map represents the designation of EFH for this life history stage based on known depth zone affinities. This includes the total area known to be within the preferred depth range for adults of this species. The depth range presented is 200 - 1300 meters (Steimle et al. 2001).

Essential Fish Habitat
Egg Life Stage
Non-Preferred Option 1

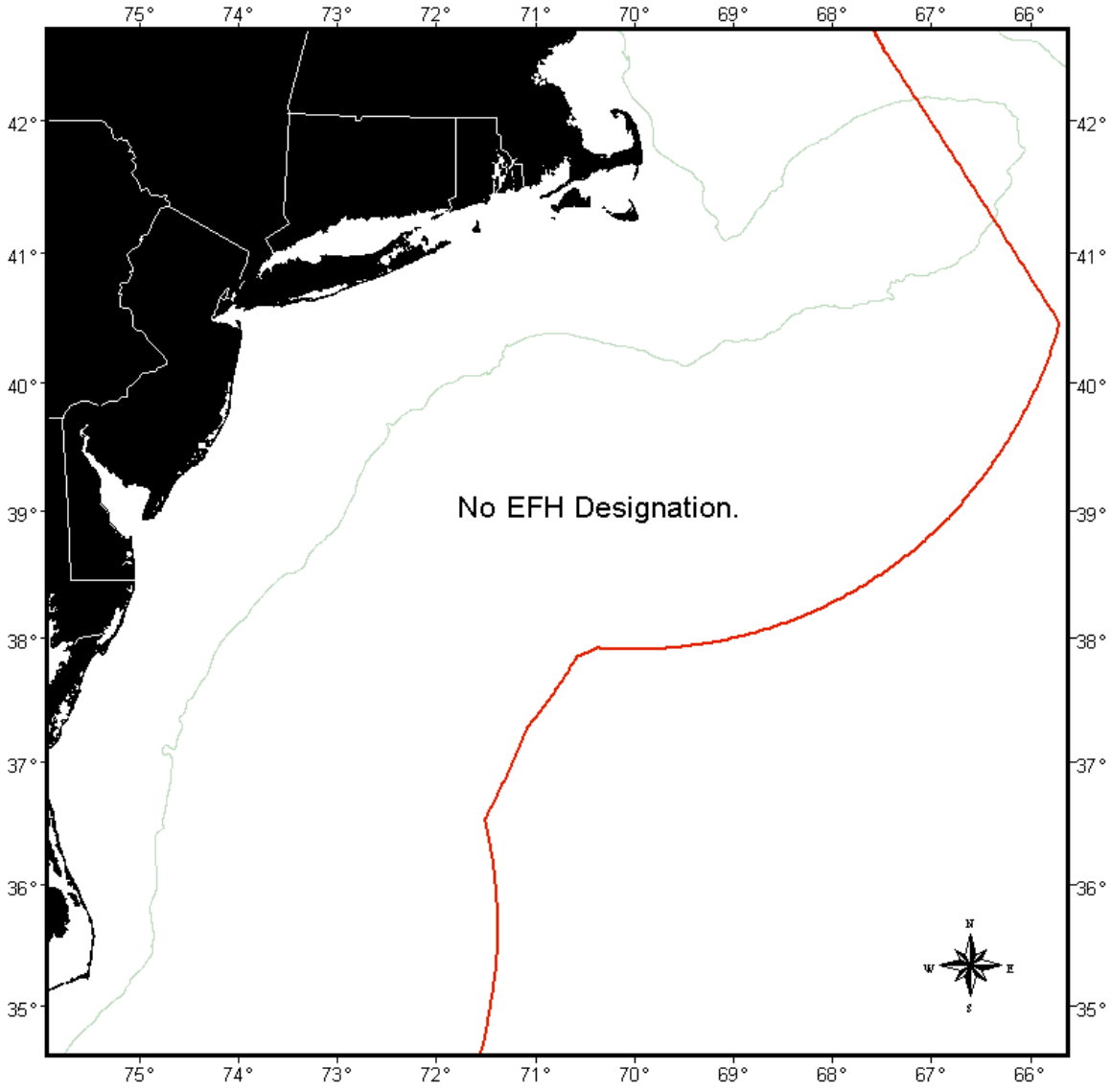

Figure 9: Egg life stage EFH option 1. This map represents an option for the designation of EFH for this life history stage based on known depth zone affinities. This option is actually to have no EFH designation for this life stage of the species, due to the fact that the eggs are not independent of the adult females. Since EFH for adults is determined separately, a distinct EFH designation for eggs may be redundant and unnecessary.

Essential Fish Habitat
Egg Life Stage
Non-Preferred Option 2

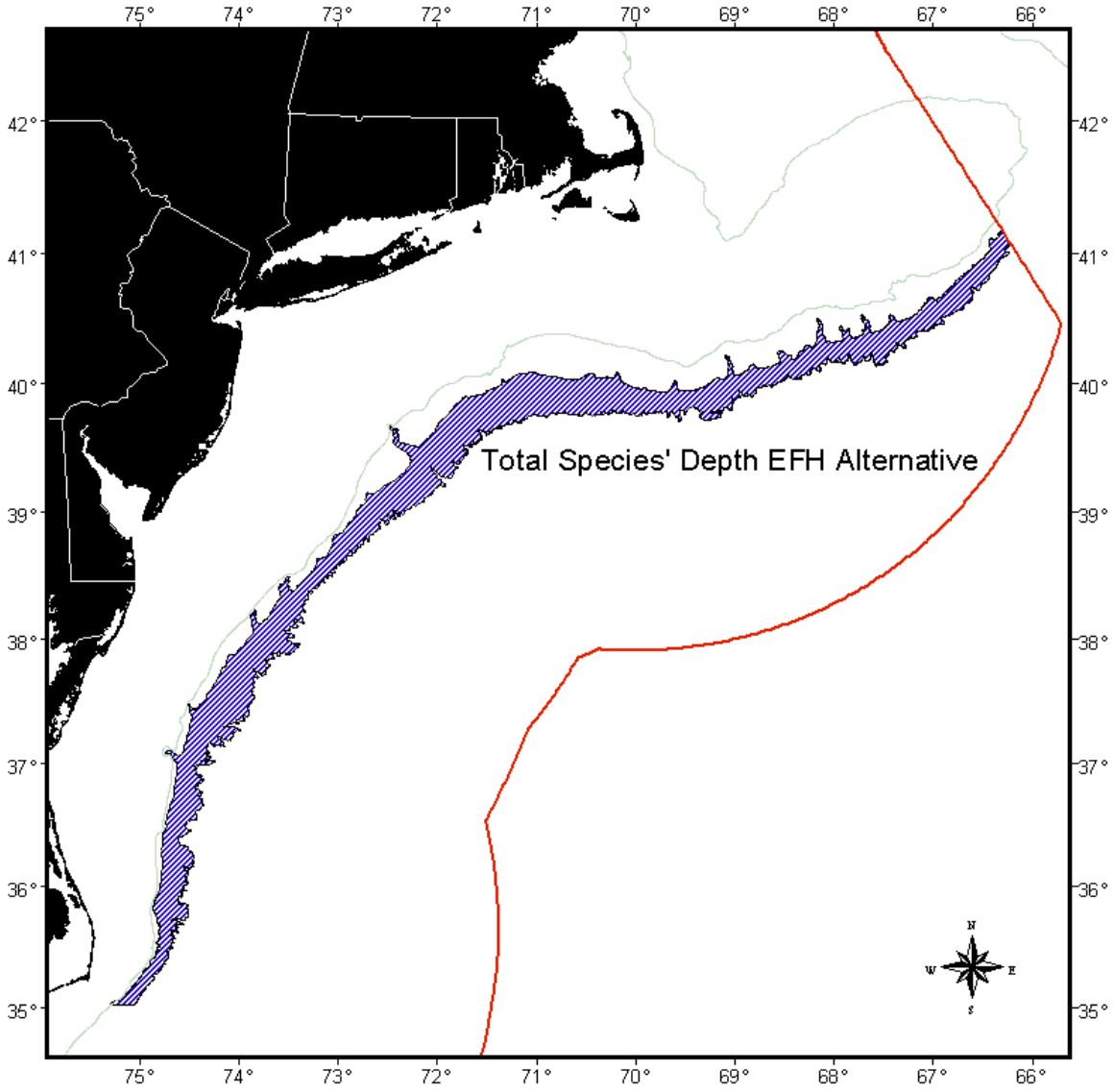

Figure 10: Egg life stage EFH option 2. This map represents an option for the designation of EFH for this life history stage based on known depth zone affinities. This option provides the broadest possible delineation based on known depth ranges by utilizing the union of the full adult and juvenile depth ranges, 200 - 1800 meters (Steimle et al. 2001).

Essential Fish Habitat
Juvenile Life Stage
Non-Preferred Option 1

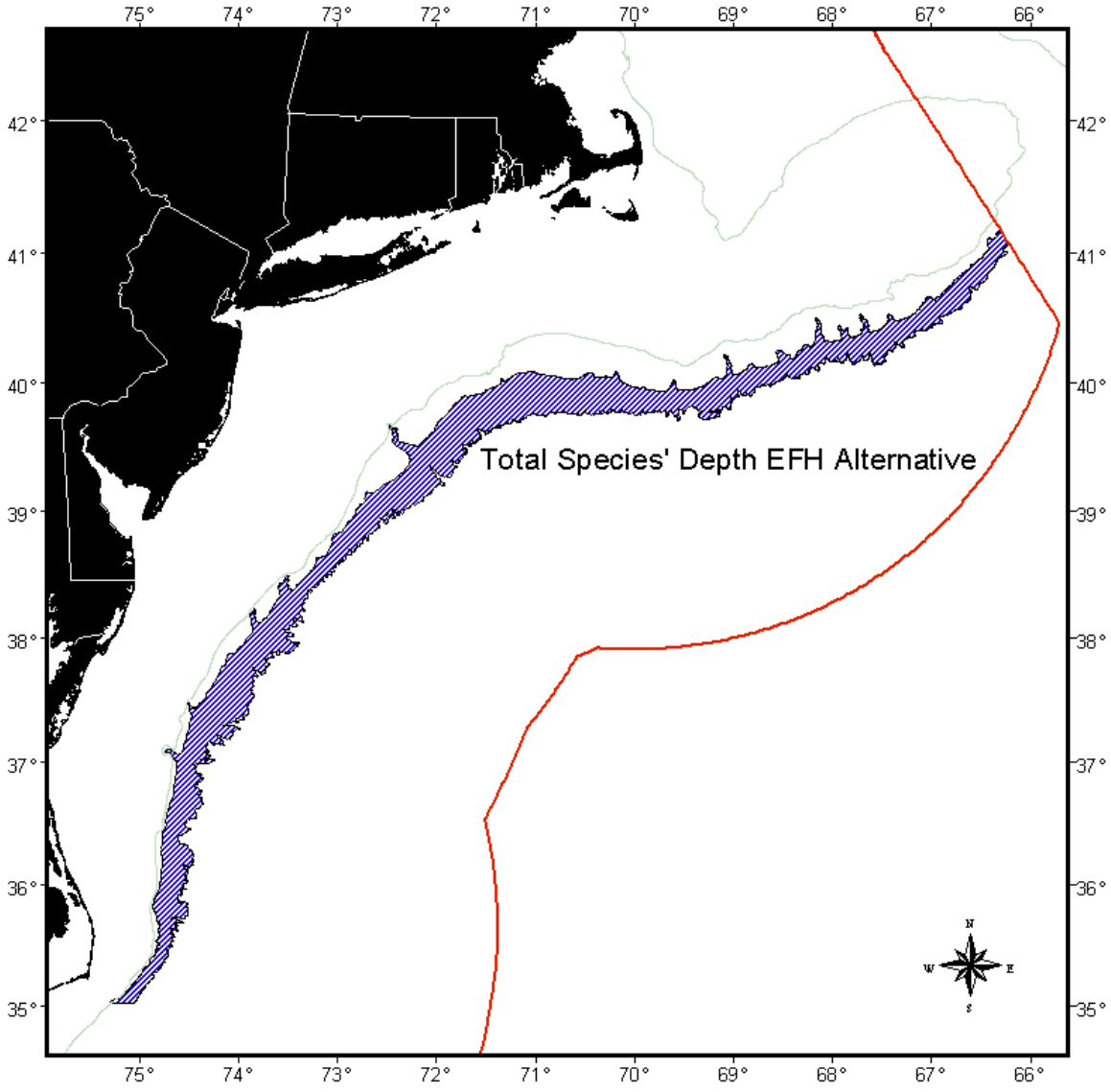

Figure 11: Juvenile life stage EFH option 1. This map represents an option for the designation of EFH for this life history stage based on known depth zone affinities. This option provides the broadest possible delineation based on known depth ranges by utilizing the union of the full adult and juvenile depth ranges, 200 - 1800 meters (Steimle et al. 2001).

Essential Fish Habitat
Adult Life Stage
Non-Preferred Option 1

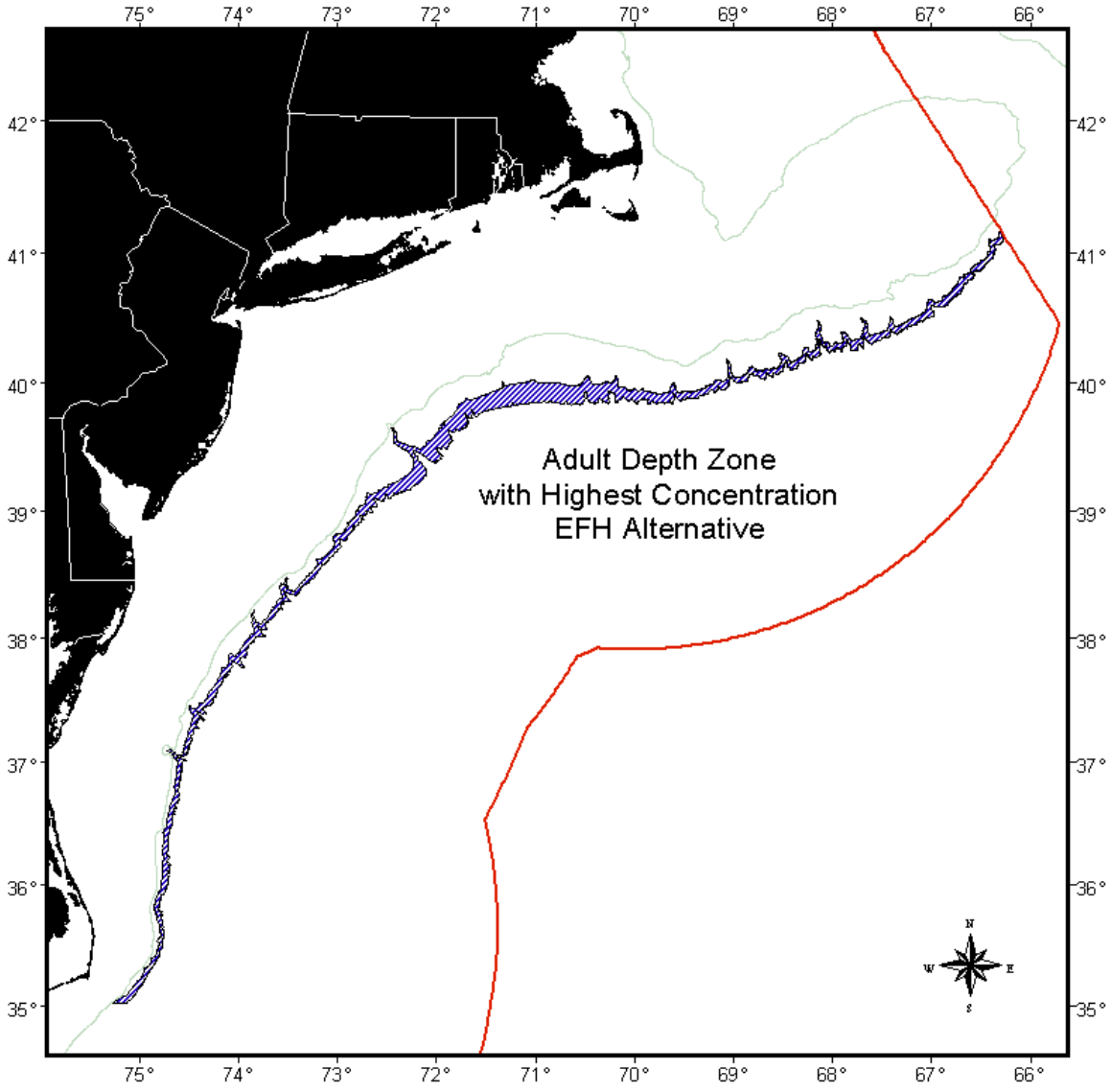

Figure 12: Adult life stage EFH option 1. This map represents an option for the designation of EFH for this life history stage based on known depth zone affinities. This option includes the total area known to be within the depth range containing the highest concentrations of adults of this species. The depth range presented is 320 - 914 meters (Wigley et al. 1975).

Essential Fish Habitat
Adult Life Stage
Non-Preferred Option 2

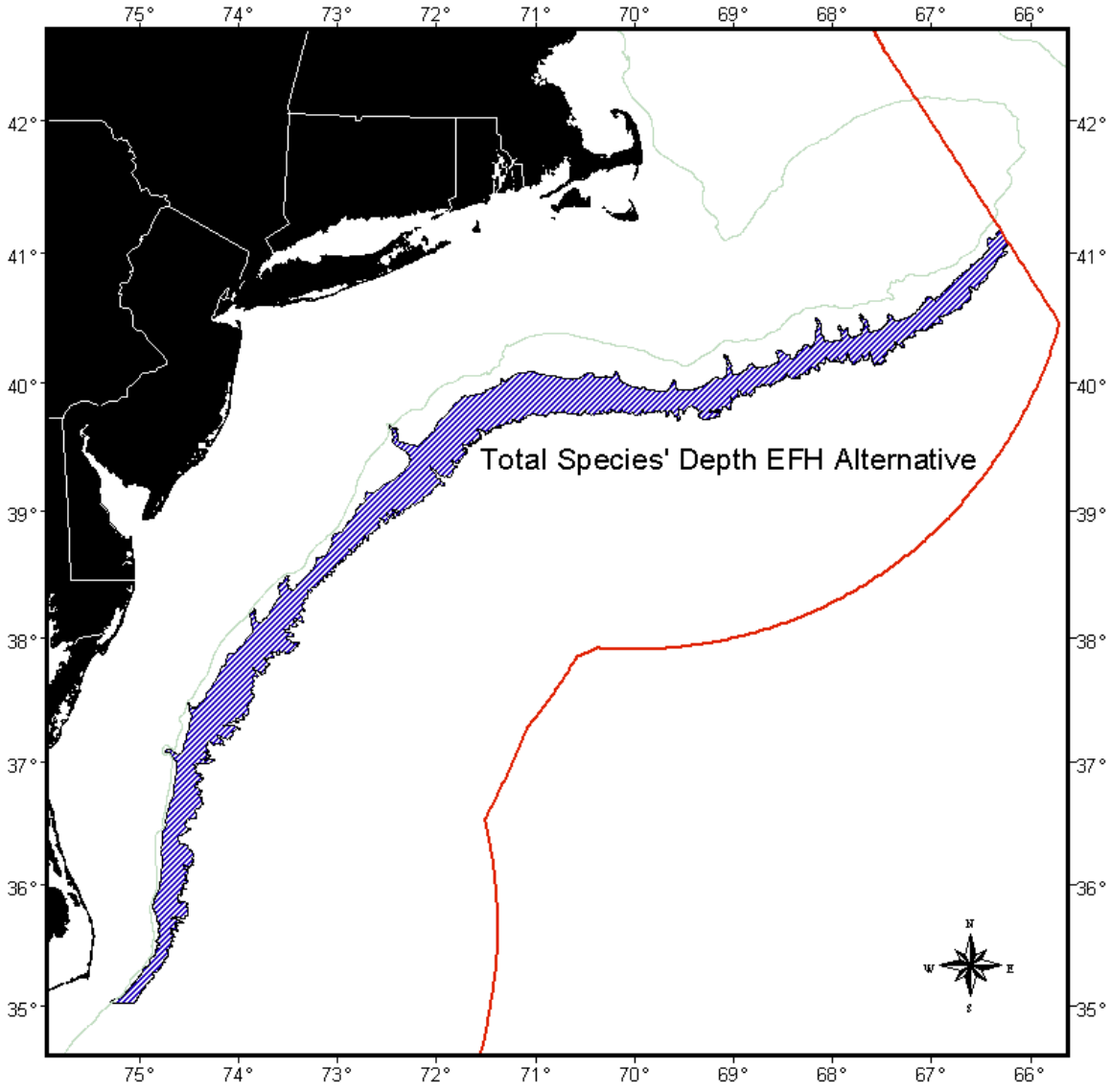

Figure 13: Adult life stage EFH option 2. This map represents an option for the designation of EFH for this life history stage based on known depth zone affinities. This option provides the broadest possible delineation based on known depth ranges by utilizing the union of the full adult and juvenile depth ranges, 200 - 1800 meters (Steimle et al. 2001).

3.7.5 Habitat Areas of Particular Concern

According to the language of the NMFS EFH Final Rule (67 FR 2343), EFH that is judged to be particularly important to the long-term productivity of populations of one or more managed species, to be particularly vulnerable to degradation, or to be particularly rare should be identified as a "habitat area of particular concern" (HAPC) to help provide additional focus for conservation efforts. The rule provides the four basic criteria for consideration of an area for HAPC designation. The four criteria are:

(1) the importance of the ecological function provided by the habitat;

(2) the extent to which the habitat is sensitive to human-induced environmental degradation;

(3) whether, and to what extent, development activities are, or will be, stressing the habitat type; and

(4) the rarity of the habitat type.

The Final Rule also specifies that habitats that are particularly vulnerable to specific fishing equipment types should be identified for possible designation as habitat areas of particular concern. The intent of the HAPC designation is to identify those areas that are known to be important to species which are in need of additional levels of protection from adverse impacts (fishing or non-fishing). Designation of habitat areas of particular concern is intended to determine what areas within EFH should receive more of the Council's and NMFS' attention when providing comments on federal and state actions, and in establishing higher standards to protect and/or restore such habitat.

For the purposes of the Council's HAPC designation process, the criteria identified by NMFS in the EFH Final Rule are considered to be defined as follows:

Importance of *Historic* Ecological Function - The area or habitat feature proposed for HAPC designation at one time provided an important ecological function to a currently managed species, but no longer provides that function due to some form of degradation. An important ecological function could include, but is not limited to, protection from predation, increased food supply, appropriate spawning sites, egg beds, etc. The importance of the ecological function should be documented in scientific literature and based on either field studies, laboratory experiments, or a combination of the two.

Importance of *Current* Ecological Function - The area or habitat feature proposed for HAPC designation currently provides an important ecological function to a managed species. An important ecological function could include, but is not limited to, protection from predation, increased food supply, appropriate spawning sites, egg beds, etc. The importance of the ecological function should be documented in scientific literature and based on either field studies, laboratory experiments, or a combination of the two.

Sensitivity to Anthropogenic Stresses – The area or habitat feature proposed for HAPC designation is particularly sensitive (either in absolute terms or relative to other areas and/or habitat features used by the target species) to the adverse effects associated with anthropogenic activities. These activities may be fishing or non-fishing related. The stress or activity must be a recognizable threat to the area of the proposed HAPC.

Extent of Current or Future Development Stresses – The area or habitat feature proposed for HAPC designation faces either an existing and on-going development-related threat or a planned or foreseeable development-related threat. Development-related threats may result from, but are not limited to, activities such as sand mining for beach nourishment, gravel mining for construction or other purposes, the filling of wetlands, salt marsh, or tidal pools, shoreline alteration, channel dredging (but not including routine maintenance dredging), dock construction, marina construction, etc.

Rarity of the Habitat Type – The habitat feature proposed for HAPC designation is considered "rare" either at the scale of the New England region or at the scale of the range of at least one life history stage of one or more Council-managed species. A "rare" habitat feature is that which is considered to occur infrequently, is uncommon, unusual, or highly valued owing to its uniqueness. Keep in mind that the term "rare" usually implies unusual quality and value enhanced by permanent infrequency. We may usually think of rare habitats or features as those that are spatially or temporally very limited in extent, but it could also be applied to a unique combination of common features that occur only in a very few places.

The Council has reviewed the available information on deep-sea red crabs and their habitat (see Section 8.2 and Appendix A), and is not proposing any HAPCs for red crab at this time. The current information suggests no areas or habitat types identified as EFH for red crab that meet any of the above criteria specified for the consideration of an HAPC. If new or additional information on red crabs and their habitat is obtained by the Council that indicates there are specific areas or habitat types designated as EFH for red crab that meet one or more of the above HAPC criteria, the Council would consider designating an HAPC at the appropriate time.

The Council has developed a formal process for the solicitation, preparation, review and designation of potential HAPCs based on the best available information. This process is described in the Council's 2000 Habitat Annual Review Report (NEFMC 2000b). This process will apply to the future consideration of HAPCs for deep-sea red crab.

3.7.6 EFH Assessment

This EFH Assessment is provided pursuant to 50 CFR 600.920.

3.7.6.1 Description of the Proposed Action

See Section 4.2 for a description of the proposed action, to implement management

measures for the deep-sea red crab fishery. The activity managed by this proposed action, fishing for deep-sea red crab, occurs in a limited area and narrow depth band along the continental slope of the United States, from the southern flank of Georges Bank south to Cape Hatteras, North Carolina, in depths between 400 and 800 meters (see Figure 23). The range of this activity occurs across the designated EFH of eleven species managed by the New England, Mid-Atlantic, and South Atlantic Fishery Management Councils. These species are identified in Table 11. Managed species not listed in Table 11 either do not have EFH designated within the area of the red crab fishery (e.g., Atlantic herring eggs) or are not demersal species (e.g., Atlantic herring juveniles and adults, bluefish, Atlantic billfish) and would not be expected to be impacted by this activity. Please refer to the New England Council's Omnibus EFH Amendment, the Summer Flounder, Scup and Black Sea Bass FMP, the Tilefish FMP, and the Golden Crab FMP for relevant information on the characteristics and distribution of EFH designated for these species. EFH designated for species managed under the Secretarial Highly Migratory Species FMPs is not affected by this action, nor is EFH designated for any other species managed by the South Atlantic Council as all of the relevant species are pelagic and not directly affected by benthic habitat impacts.

Species	Council
Monkfish	New England
Offshore Hake	New England
Red Hake	New England
Redfish	New England
White Hake	New England
Whiting	New England
Witch Flounder	New England
Black Sea Bass	Mid-Atlantic
Scup	Mid-Atlantic
Tilefish	Mid-Atlantic
Golden Crab	South Atlantic

Table 11: List of demersal species for which EFH is designated in the area of the red crab fishery.

3.7.6.2 Analysis of the Effects of the Proposed Action

The most likely result of this proposed action is to decrease the level of red crab fishing occurring in the U.S. EEZ to below current levels, or at least below the levels of red crab fishing that (a) were occurring prior to the implementation of the emergency regulations; and (b) would occur in the absence of this management plan. This action is expected to limit the capacity of the red crab fishery and prevent expansion of the fishery above levels that existed prior to March of 2000. This action prohibits the use of any type of fishing gear other than a red crab trap/pot in the directed fishery, including otter trawls and dredges, and limits all vessels in the directed fishery to no more than 600

traps/pots. This action does not propose to alter where fishing for red crab is prosecuted. The allowable fishing gear utilized to harvest red crab in the directed fishery has not been shown to have an adverse impact to the EFH of any species (see Section 8.2.3). Due to the size of this fishery (a very small fishery with only five vessels expected to qualify for the controlled access directed fishery), the limited amount of gear allowed for each vessel (600 pots per vessel), the prohibition on other gear types and the prevention of an expansion of fishing effort, this action is not expected to contribute impacts to the EFH of any managed species. Potential impacts to EFH associated with this fishery would be expected to decrease as a result of this action based on the overall controls on the fishery, the trap/pot limit, the non-trap/pot gear prohibition, and the controlled access program which will limit the number of participants.

3.7.6.3 Conclusions

The red crab fishery has been determined to have no identifiable adverse effects on EFH, therefore no specific management alternatives for minimizing the adverse effects of fishing are necessary. Several management measures intended to serve multiple purposes (resource conservation, effort control, etc.) also provide direct benefits to habitat. These measures include trap limits (Section 4.2.5), controlled access (Section 4.2.9), and a prohibition on non-trap gear (Section 4.2.6).

The action proposed under this Fishery Management Plan should have at most a minimal adverse effect on the EFH of species managed by the New England, Mid-Atlantic or South Atlantic Fishery Management Councils (although no adverse impacts are expected). This FMP minimizes to the extent practicable adverse effects on EFH caused by fishing pursuant to 50 CFR Part 600.815(a)(2)(ii). Because there are less than substantial adverse impacts associated with this action, an abbreviated consultation should be all that is required.

3.7.6.4 Proposed Mitigation

A description of the alternatives considered but not selected by the Council is provided in Section 4.0. No further mitigation is practicable or necessary.

3.8 Permits and Reporting and Record-Keeping Requirements

Prior to the implementation of the emergency regulations on May 18, 2001, there was no requirement for any type of permit in order to fish for deep-sea red crab in the U.S. EEZ. In order to control and track the fishing effort for red crabs within the Council's management area, federal permits will be required for all vessels, operators and dealers engaged in any aspect of the red crab fishery.

Throughout the development of the FMP, the Council stressed the need for the collection of information on the red crab fishery, including fishery-dependent data on harvests and landings of red crabs. The FMP therefore includes several requirements for record-keeping and reporting, at both the fishing vessel and dealer/processor level. The Council considered the components of the Atlantic Coastal Cooperative Statistics Program (ACCSP) to ensure that they are addressed in the Red Crab FMP and that the reporting requirements implemented in the FMP are consistent with the ACCSP program.

3.8.1 Vessel Permits

3.8.1.1 Controlled Access Permit

For a person aboard a fishing vessel to fish for, possess, off-load, or sell more than the incidental catch limit of deep-sea red crab in or from the EEZ within the Council's management area for this FMP, a valid controlled access vessel permit for red crab must be issued to the vessel and be on board. The FMP will require that annual controlled access permits be renewed at least 180 days prior to the start of the fishing year, and that the permit renewal application include a binding declaration either into or out of the fishery for the following fishing year. If a vessel does not explicitly indicate whether they will be in or out of the fishery for the coming year, they will be considered to have declared into the fishery for administrative purposes. If a vessel declares into the fishery, they of course retain the ability to determine their own level of appropriate participation. If a vessel declares out of the fishery for the following year, this decision is binding and they will have to wait until the next year's permit renewal application process to declare back into the fishery for the next full fishing year.

There is no fee for these permits at this time; however, this does not preclude the Regional Administrator from charging a fee at some time in the future to recover administrative expenses of issuing a permit required under this section. The amount of the fee will be calculated in accordance with the procedures of the NOAA Finance Handbook, available from the Regional Administrator, for determining administrative costs of each special product or service. The fee may not exceed such costs and is specified with each application form. Red crabs taken from the EEZ by any vessel issued a Federal red crab permit may only be sold to Federally-permitted dealers. Because all catches occur in the EEZ (red crabs are not harvested in state waters), it is considered a rebuttable presumption that a vessel with red crab aboard harvested the crabs from the EEZ.

Vessel permits will enable the universe of participants to be known and, if

necessary, control their access to the resource. Requiring permits is a necessary component to meet the objective of collecting the data and information necessary to monitor and assess the fishery. These data are necessary for the long-term productivity and sustainability of the red crab resource and for the Council to increase enforcement compliance and achieve optimum yield.

3.8.1.2 Open Access Incidental Catch Permit

For a person aboard a fishing vessel to fish for, possess, off-load, or sell less than the incidental catch limit of deep-sea red crab in or from the EEZ within the Council's management area for this FMP, a valid open access incidental catch vessel permit for red crab must be issued to the vessel and be on board. The FMP requires an open access incidental catch permit for all vessels who do not qualify to participate in the directed red crab fishery but still wish to land small amounts of red crab, up to the incidental catch limit (see Section 4.2.1).

There is no fee for these permits at this time; however, this does not preclude the Regional Administrator from charging a fee at some time in the future to recover administrative expenses of issuing a permit required under this section. The amount of the fee will be calculated in accordance with the procedures of the NOAA Finance Handbook, available from the Regional Administrator, for determining administrative costs of each special product or service. The fee may not exceed such costs and is specified with each application form. Red crabs taken from the EEZ by any vessel issued a Federal red crab permit may only be sold to Federally-permitted dealers. Because all catches occur in the EEZ (red crabs are not harvested in state waters), it is considered a rebuttable presumption that a vessel with red crab aboard harvested the crabs from the EEZ.

Vessel permits will enable the universe of participants to be known and, if necessary, control their access to the resource. Requiring permits is a necessary component to meet the objective of collecting the data and information necessary to monitor and assess the fishery. These data are necessary for the long-term productivity and sustainability of the red crab resource and for the Council to increase enforcement compliance and achieve optimum yield.

3.8.2 Operator Permit

Operators of commercial vessels permitted to harvest deep-sea red crab will be required to obtain and make available for inspection a valid operator permit. No performance or competency tests will be required to obtain a permit. The permit may be revoked for violation of fishing regulations.

Any operator of a vessel fishing for red crab must have an operator's permit issued by the NMFS Regional Administrator. An operator is defined as the master or other individual on board a vessel who is in charge of the vessel. (Note: This definition is specified in the Code of Federal Regulations, 50 CFR 648.5.) The operator will be required to submit an application, supplied by the Regional Administrator, for an

Operator's Permit. The permit will be issued for up to three years. The applicant will provide his/her name, mailing address, telephone number, date of birth and physical characteristics (height, weight, hair and eye color, etc.) on the application, and will be requested to provide his/her social security number. In addition to this information, the applicant will be required to provide two passport-size color photos.

Permit holders will be required to carry their permit aboard the fishing vessel during fishing and off-loading operations. It must be available for inspection upon request by an authorized officer. There is no fee for this permit at this time; however, this does not preclude the Regional Administrator from charging a fee at some time in the future to recover administrative expenses of issuing a permit required under this section. The amount of the fee will be calculated in accordance with the procedures of the NOAA Finance Handbook, available from the Regional Administrator, for determining administrative costs of each special product or service. The fee may not exceed such costs and is specified with each application form.

Requiring permits is a necessary component to meet the objectives of enforcement and collecting the data and information necessary to monitor and assess the fishery. These data are necessary for the long-term productivity and sustainability of the red crab resource and for the Council to increase enforcement compliance and achieve optimum yield.

3.8.3 Dealer Permit

A dealer who receives red crab must obtain an annual dealer permit for red crab. To be eligible for such permit, an applicant must have a valid state wholesaler's license in the state where he or she operates.

There is no fee for this permit at this time; however, this does not preclude the Regional Administrator from charging a fee at some time in the future to recover administrative expenses of issuing a permit required under this section. The amount of the fee will be calculated in accordance with the procedures of the NOAA Finance Handbook, available from the Regional Administrator, for determining administrative costs of each special product or service. The fee may not exceed such costs and is specified with each application form. To purchase red crab harvested in the EEZ from a fisherman, a person or business (including a restaurant) must have a Federal dealer permit. Red crabs taken from the EEZ may only be sold to Federally permitted dealers, and Federally permitted dealers may only purchase red crab from Federally permitted vessels. Because all catches occur in the EEZ (red crabs are not harvested in state waters), it is considered a rebuttable presumption that a vessel with red crab aboard harvested the crabs from the EEZ.

Requiring permits is a necessary component to meet the objective of collecting the data and information necessary to monitor and assess the fishery. These data are necessary for the long-term productivity and sustainability of the red crab resource and for the Council to increase enforcement compliance and achieve optimum yield.

3.8.4 Observers and Sea Sampling

The NMFS Regional Administrator may request any vessel holding a red crab permit to carry a NMFS-approved sea sampler/observer. If requested by the Regional Administrator to carry an observer or sea sampler, a vessel may not engage in any fishing operations in the red crab fishery unless an observer or sea sampler is on board, or unless the requirement is waived.

If requested by the Regional Administrator to carry an observer or sea sampler, it is the responsibility of the vessel owner to arrange for and facilitate observer or sea sampler placement. Owners of vessels selected for sea sampler/observer coverage must notify the appropriate Regional or Science and Research Director, as specified by the Regional Administrator, before commencing any fishing trip that may result in the harvest of resources of the red crab fishery. Notification procedures will be specified in selection letters to vessel owners.

For domestic vessels, observers will normally be funded through the NMFS observer program. In the future, innovative methods of funding observers may include industry sponsored initiatives.

3.8.5 Vessel Reporting

3.8.5.1 Interactive Voice Response

Fishing vessels permitted to participate in the controlled access directed red crab fishery will be required to utilize the Interactive Voice Reporting (IVR) system, as was required during the emergency regulatory period, to report the total red crab landings of each trip as well as other information deemed necessary within 24 hours after returning to port and off-loading, as required by the Regional Administrator. The IVR system employs an automated toll-free telephone call-in program.

The use of the IVR system will enable NMFS and the Council to track landings on a near-real time basis. The Council will propose annual adjustments to DAS allocations and changes to the target TAC based on information about landings and DAS use. IVR reporting does not exempt the owner or operator from other applicable reporting requirements of §648.7. This requirement applies only to vessels holding a controlled access permit for the red crab fishery and applies to all fishing trips during which they land any amount of red crab (not necessarily only those trips on which they land more than the incidental catch limit). The IVR requirement does not apply to vessels holding an open access incidental catch red crab permit.

3.8.5.2 Vessel Trip Reports

The owner or operator of a vessel for which either a controlled access or an open access permit for red crab has been issued must maintain a logbook form for each fishing trip on a form supplied by or approved by the Regional Administrator. Among other things, the logbook forms provide a record of fishing locations, time fished, fishing effort, and bycatch information. The forms should also provide for the recording of

economic data such as variable costs and prices paid. Logbook forms must be submitted to the Regional Administrator postmarked or received within 15 days after the end of the reporting month. If no fishing occurred during a month, a report so stating must be submitted in accordance provided with the forms.

This requirement applies to all vessels permitted to fish for red crab under either a controlled access permit or an open access incidental catch permit. The owner or operator of a vessel must provide data and must comply with any requirements regarding landing red crab and any associated bycatch. The Council is requiring 100% logbook coverage due to the lack of data and the importance of this information. Also, the owner or operator of a vessel must make their catch available for biological sampling (including port sampling) and, if required, must carry an observer.

If the Council and the Regional Administrator agree that a suitable electronic data recording and submission technology exists for implementation on red crab fishing vessels, the owner or operator of a vessel may choose, as an alternative to the logbook, to submit the required data electronically. Vessels would be allowed to provide the required data to NMFS (or have the required data provided to NMFS on their behalf) in either hardcopy or electronic format. If on hardcopy, the appropriate Vessel Trip Report (VTR) form would be used. If electronic, the format and content of the data would have to meet any and all criteria established by the Council in consultation with NMFS.

Vessels licensed to participate in the directed red crab fishery would also be subject to the reporting requirements of the Marine Mammal Protection Act (MMPA). Under these provisions of the MMPA, vessels must report any incidental mortality or injury to a marine mammal during commercial fishing activities. This report is required within 48 hours after the end of the fishing trip. A reporting form can be provided by the NMFS Northeast Regional Office.

The owner or operator of any vessel issued a valid controlled access or open access incidental catch permit for red crab must maintain on board the vessel and submit an accurate fishing log report for each fishing trip, regardless of whether red crab was fished for or taken, on forms supplied by or approved by the NMFS Regional Administrator. If authorized in writing by the Regional Administrator, a vessel owner or operator may submit reports electronically, for example by using a VMS or other media (as noted above). At a minimum, the following information and any other information required by the Regional Administrator, must be provided:

a. vessel name;

b. USCG documentation number (or state registration number, if undocumented);

c. permit number;

d. date/time sailed;

e. date/time landed;

f. trip type;

g. number of crew;

h. type of gear fished;

i. quantity and size of gear (this is intended to represent the total number of pots employed by a vessel in their fishing operations);

j. mesh/ring size, if non-trap gear (in the open access incidental catch fishery);

k. chart area fished;

l. average depth fished;

m. latitude/longitude (or loran station and bearings);

n. total hauls per area fished (this is intended to represent the total number of pots hauled in the area during the trip, such that the quotient of the total landings from the area divided by the total number of pots hauled is equal to the average catch per trap);

o. average tow time duration;

p. hail weight, in pounds, by species, of all species, or parts of species, such as monkfish livers, landed or discarded (weight of red crab landed must reflect the appropriate recovery rate conversion formulas);

q. dealer permit number;

r. dealer name;

s. date sold, port and state landed; and

t. vessel operator's name, signature, and operator's permit number.

3.8.5.3 Voluntary Subsampling Protocol

The owner of any vessel issued a controlled access permit for red crab may volunteer to participate in a data collection program for the purpose of counting and recording the complete catch, including juveniles of both sexes, of at least one trap per trap trawl on the fishing trip on which they are participating in this program. The report, to be submitted on specially designed forms that can be obtained from the Regional Administrator, shall be separate and apart from other record-keeping and reporting requirements of the FMP. Vessels choosing to participate in this data collection program will count and record the complete catch (including females and juvenile males) of at least one trap per trap trawl on a fishing trip. The following would be recorded for each trap haul:

a. date, time, and location (in latitude and longitude) of trap haul;

b. the number of males;

c. the number of females;

d. the size of each crab noted above, in millimeters of carapace width, by sex; and

e. the species, numbers, and sizes of all other organisms brought up in the trap.

3.8.6 Dealer Reporting

A dealer who has been issued an annual dealer permit for red crab must provide, on forms supplied by or approved by the Regional Administrator, all red crab purchases and prices paid to the Regional Administrator. This information must be provided weekly, and must be postmarked and received within 16 days after the end of each reporting week. The following information would be provided by all seafood dealers licensed to participate in the red crab fishery. All seafood dealers, whether U.S.-based or foreign-based, if they are Federally-permitted to participate in the red crab fishery, will be required to provide this information. If authorized in writing by the Regional Administrator, dealers may submit reports electronically or through other media. The following information, and any other information required by the Regional Administrator, must be provided in the report:

a. dealer name and mailing address;

b. dealer permit number;

c. name and permit number or name and hull number (USCG documentation number or state registration number, whichever is applicable) of vessels from which red crabs are landed or received;

d. trip identifier for a trip from which red crabs are landed or received;

e. dates of purchases;

f. pounds of red crab received, by market category;

g. price per pound, by market category, or total value, by market category;

h. port landed;

i. signature of person supplying the information; and

j. any other information deemed necessary by the Regional Administrator.

The dealer or other authorized individual must sign all report forms. If no red crabs are purchased during a reporting week, no written report is required to be submitted. If

no red crabs are purchased during an entire reporting month, a report so stating on the required form must be submitted.

3.8.7 Vessel Monitoring System (VMS)

The Council considered requiring all vessels with a controlled access red crab permit to maintain VMS on their vessel for monitoring and enforcing fishing effort. VMS will not be required for red crab vessels at this time, but the Council may consider in a future action requiring VMS on all vessels fishing for red crab in the directed red crab fishery. VMS can be used to accurately track fishing effort and locations.

3.9 Council Review and Monitoring of the FMP

The Council, its Red Crab Plan Development Team (PDT), and its Advisory Panel, plan to monitor the status of the fishery and its resource following implementation of the FMP and review, on a regular basis, the need to make adjustments to the regulatory framework. The Council, working with its partners in the National Marine Fisheries Service (NMFS), will prepare a biennial Stock Assessment and Fishery Evaluation (SAFE) Report for the red crab fishery and its resource. The SAFE Report will be the primary vehicle for the presentation of all biological and socio-economic information relevant to the red crab fishery. The SAFE Reports will be intended to expand and update (where possible) the information contained in the FMP. Based on the continued monitoring of the fishery and review of the effectiveness of the measures in the FMP, if the Council determines that an adjustment to the measures is needed to continue to meet the goals and objectives of the FMP, it will implement either an annual specification process or a framework adjustment process (described below).

Although the SAFE will be completed every other year, the Council's Red Crab PDT will meet at least annually to review the status of the stock and the fishery. Based on this review, the PDT will report to the Council's Red Crab Committee, no later than five months prior to the start of the next fishing year, any necessary adjustments to the management measures adopted and recommendations for the specifications and TACs. The PDT will specifically recommend TACs for the following year and an estimated TAC for the year after. In developing these recommendations the PDT will review the following data, if they are available: commercial catch data; current estimates of fishing mortality and catch-per-unit-effort (CPUE); stock status; recent estimates of recruitment; virtual population analysis results and other estimates of stock size; sea sampling, port sampling, and survey data or, if sea sampling data are unavailable, length frequency information from port sampling and/or surveys; impact of other fisheries on the mortality of red crabs, and any other relevant information.

Based on recommendations from the Council's Red Crab PDT or other appropriate technical group which has reviewed the available information on the status of the stock and the fishery, the Red Crab Committee may recommend to the Council changes to the appropriate specifications and/or the annual TAC, as well as any measures necessary to assure that the specifications will not be exceeded. The Council shall review these recommendations and any public comment received and will recommend appropriate

specifications to the Regional Administrator. Any suggested revisions to Federal management measures may be implemented through the framework process or an amendment to the FMP.

For example, under a target TAC and DAS program, the number of DAS allocated to each vessel participating in the directed red crab fishery may be revised on an annual basis. This allocation would be based on a monitoring of the landings and comparison of these landings against the target TAC. If, in any year, it appears that the fishery will not harvest the total target TAC by the time they have used all allocated DAS, the Council may recommend increasing the number of DAS allocated to the fishery for the following year. If, on the other hand, is appears that the fishery will exceed the target TAC before they have used all allocated DAS, the Council may recommend decreasing the number of DAS allocated to the fishery for the following year.

Specifications and/or TACs will be implemented by the Regional Administrator, and may include the specification of optimum yield (OY), the setting of any hard or target TACs, allocation of days-at-sea (DAS), and/or adjustments to trip/possession limits. The annual specifications process will mimic the framework adjustment process that allows changes to be made to regulations in a timely manner without going through the full plan amendment process. To implement changes to the specifications and/or TACs, the Council will develop and analyze the proposed specifications over the span of at least two Council meetings, and provide advance public notice of the availability of both the proposals and the analyses. Opportunity to provide written and oral comments on the proposed specifications and/or TACs will be provided throughout the process before the Council submits any recommendations to the Regional Administrator.

The purpose of this process is to provide a formal opportunity for public comment that substitutes for the customary public comment period provided when publishing the proposed changes as a proposed rule in the *Federal Register*. Based on the significance of the proposed changes to the specifications and/or TACs, the Secretary of Commerce may waive the need for additional public comment that would otherwise occur through publication of a proposed rule. In these cases, the changes to the specifications and/or TACs will be published only in the form of a final rule in the *Federal Register*. The previous year's specifications will remain effective unless changed by the Regional Administrator. If the specifications will not be changed, this will be announced through a notice action.

The specifications and TACs established pursuant to the FMP may be adjusted by NMFS, after consulting with the Council, during the fishing year by publishing notification in the *Federal Register* stating the reasons for such action and providing an opportunity for prior public comment. Any adjustments must be consistent with the Red Crab FMP objectives and other FMP provisions. For example, adjustments may be made to correct for errors in estimating any of the specifications, to provide for increased opportunities for U.S. fishermen to use the resource, or to address conservation concerns.

Based on the starting date for the fishing year selected for this fishery (March 1), the FMP will be implemented mid-year. As such, the first annual review and adjustment

will be proposed for the start of the 2004 fishing year (March 1, 2004 - February 28, 2005). This ensures that the measures to be implemented in the FMP will be in place for at least one year prior to review and possible adjustment. Also, because this FMP will be implemented in the middle of the fishing year, the allowable TAC, allocations of DAS, or other measures may be prorated to account for the partial first fishing year.

The amount of the proration will be based on the percentage of the target TAC remaining when the FMP or measures proposed in the FMP are to be implemented. The first year the Red Crab FMP is implemented (the time between when the FMP is implemented after the final rule is published in the *Federal Register* and when the next fishing year begins on March 1, 2003) presents a unique situation related to the specification of a target TAC and the allocation of DAS to all vessels who receive a controlled access red crab permit. Rather than determine the total fleet DAS available based on the target TAC and an estimated average per DAS landing efficiency, a baseline of 130 DAS per vessel will be used in the first year of implementation. The calculation of 130 DAS per vessel is based on a conservative estimate of per day landing efficiency and an assumption that six vessels may qualify for the controlled access fishery.

The Regional Administrator will have to estimate the amount of landings from any hiatus period based upon the best available data and projections. The Regional Administrator will also have to calculate the amount of red crab landed (based on reporting requirements) during the initial implementation period of the FMP before the controlled access program and DAS are implemented. These two landings totals should be combined and deducted from the target TAC of 5.928 million pounds. The result will represent the amount of the target TAC available for the remainder of the first fishing year, to be fished under the DAS program. The Regional Administrator should calculate the percentage of the target TAC that remains available to the fishery. Vessels that qualify to fish for red crab under the controlled access/DAS program should be allocated this percentage of the initial baseline of DAS (i.e., a percentage of 130 DAS).

For example, if there is a two week hiatus period between the expiration of the emergency regulations and the implementation of the FMP, we may be able to estimate that 580,000 pounds of red crab would be landed in that time period (this is based on the landings from the first four weeks of the second emergency period, when 290,000 pounds were landed per week, on average). If there is a one-month delay between the initial implementation of the FMP and the implementation of the DAS program, we may record additional landings on the order of 1.16 million pounds (based on an extension of the above estimate). This would result in a total landings estimate of 1.740 million pounds prior to the implementation of the DAS program. This amount would be deducted from the 5.928 million pound target TAC to determine that there are approximately 4.187 million pounds of the TAC remaining for the fishery. This is 70.6% of the original TAC, so each vessel would be allocated 70.6% of the initial DAS baseline for the remainder of the fishing year, or $70.6\% \times 130 = 91.8 \approx 92$ DAS. While this may seem a low allocation, this would be for, in this example, the period from July 1, 2002 - February 28, 2003. This period of time represents 242 days, or 66.3% of the year. Extrapolating out from this amount, an allocation of 92 DAS for the partial year is equivalent to an allocation of 139 DAS for a full fishing year, just over what was determined to be a

reasonable baseline in the above steps. It should also be remembered and taken into account that the red crab vessels allocated DAS as described above will have been able to fish during the time between when the emergency regulations expire (May 15, 2002) and when the controlled access/DAS program is implemented.

For the first full fishing year, March 1, 2003 - February 29, 2004, each vessel authorized to participate in the controlled access directed fishery will be allocated 156 DAS, unless this allocation is changed under the FMP specification process described above. The target TAC for the first full fishing year will be 5,928,000 pounds of whole red crab or their equivalent. The target TAC of 5,928,000 pounds and an allocation of 156 DAS per controlled access vessel will remain the baseline until these amounts are modified through the specification process.

3.10 Framework Adjustments

Many management measures in the Red Crab FMP can be changed or adjusted via a "framework" action. The effectiveness of the management program depends somewhat on uncertain factors that may change over time. Achieving the FMPs goals and objectives may require at least annual adjustments to the management measures. It is therefore necessary to have an administrative mechanism in place that fulfills the Council's public input and notification requirements while maximizing flexibility and responsiveness.

The framework adjustment process allows changes to be made in regulations in a timely manner without going through the full plan amendment process. The purpose is to provide a formal opportunity for public comment that substitutes for the customary public comment period provided when publishing a proposed rule. If changes to the management measures were contemplated in the FMP, there was sufficient opportunity for public comment on the framework action, and the changes are not highly controversial, the Secretary of Commerce may waive the need for additional public comment that would otherwise occur through publication of a proposed rule in the *Federal Register*. In these cases, the changes to the regulations are published only in the form of a final rule in the *Federal Register*.

Framework actions must be given the same consideration as to the potential impacts of the action as are FMPs and FMP amendments. The essence of the framework concept is the adjustment of management measures within the scope and criteria established by the FMP and implementing regulations to provide real-time management of fisheries. Framework measures may be "open" measures that provide the Council with a given set or limit of options to apply to a fishery through a regulatory amendment process, or more traditional "closed" measures such as closures, seasons, or gear restrictions. Closed measures are implemented through in-season rule related notices. Analysis for FMPs, FMP amendments, and regulatory amendments that establish a framework process should, to the extent possible, assess the full range of impacts that would likely result from the options considered under any future framework action. This will reduce the scope of analysis required for subsequent actions established under the framework process.

3.10.1 Framework Adjustment Process

To implement a framework adjustment for the Red Crab FMP, the Council will develop and analyze proposed actions over the span of at least two Council meetings, and provide advanced public notice of the availability of both the proposals and the analyses. Opportunity to provide written and oral comments will be provided throughout the process before the Council submits any recommendations to the Regional Administrator.

In response to an annual review of the status of the fishery or the resource by the Red Crab PDT or at any other time, the Council may recommend adjustments to any of the measures proposed by this FMP. The Red Crab Oversight Committee may request that the Council initiate a framework adjustment. Framework adjustments will require one initial meeting (the agenda must include notification of the impending proposal for a framework adjustment) and one final Council meeting.

After a management action has been initiated, the Council will develop and analyze appropriate management actions within the scope identified below. The Council may refer the proposed adjustments to the Red Crab Committee for further deliberation and review. Upon receiving the recommendations of the oversight committee, the Council will publish notice of its intent to take action and provide the public with any relevant analyses and opportunity to comment on any possible actions. After receiving public comment, the Councils must take action (to approve, modify, disapprove, or table) on the recommendation at the Council meeting following the meeting at which it first received the recommendations. The Council's recommendation for adjustments or additions to management measures must come from one or more of the categories listed below. Documentation and analyses for the framework adjustment will be available at least two weeks before the final meeting.

After developing management actions and receiving public testimony, the Council may make a recommendation to the Regional Administrator. The Council's recommendation will include supporting rationale and, if management measures are proposed, an analysis of impacts and a recommendation to the Regional Administrator on whether to issue the management measures as a final rule. If the Council recommends that the management measures should be issued directly as a final rule, the Council will consider at least the following four factors and provide support and analysis for each factor considered:

1. Whether the availability of data on which the recommended management measures are based allows for adequate time to publish a proposed rule, and whether regulations have to be in place for an entire harvest/fishing season;

2. Whether there has been adequate notice and opportunity for participation by the public and members of the affected industry in the development of the Council's recommended management measures;

3. Whether there is an immediate need to protect the resource or to impose management measures to resolve gear conflicts; and

4. Whether there will be a continuing evaluation of management measures adopted following their implementation as a final rule.

If the Regional Administrator concurs with the Council's recommended management measures they will be published as either a final rule based on the factors specified above or as a proposed rule in the *Federal Register*. If the Council's recommendation is first published as a proposed rule and the Regional Administrator concurs with the Council's recommendation after receiving additional public comment, the measures will then be published as a final rule in the *Federal Register*.

If the Regional Administrator approves the Councils' recommendations, the Secretary may, for good cause, waive the requirement for a proposed rule and opportunity for public comment in the *Federal Register*. The Secretary, in so doing, will publish only the final rule. Submission of recommendations does not preclude the Secretary from deciding to provide additional opportunity for prior notice and comment in the *Federal Register*, but it contemplates that the Council process will adequately satisfy that requirement.

The Regional Administrator may approve, disapprove, or partially disapprove the Council's recommendation. If the Regional Administrator does not approve the Council's specific recommendation, she must notify the Council in writing the reasons for her action prior to the first Council meeting following publication of her decision. Nothing in this proposal prevents the Secretary of Commerce from soliciting additional comment, but it is contemplated that the Council's process will adequately satisfy that requirement.

3.10.2 Management Measures That Can Be Adjusted Via Framework

The management measures described below are contemplated for future framework adjustment. The impacts of changes in these measures have not been fully analyzed but fall within the scope of possible management restrictions contemplated by this FMP.

3.10.2.1 Optimum Yield

Changes to the specification of optimum yield (OY) may be implemented by the annual specifications process or by framework action. As new information becomes available on the appropriate level for MSY, on ecological, social, or economic factors that are related to OY, or other information on the stock or its fishery that may affect the specification of OY, the Council may adjust OY to better reflect and account for this new information. This adjustment may be necessary to incorporate specific data about the fishery or the resource, or may be necessary to account for a better understanding of the vulnerability of the resource to fishing pressure.

3.10.2.2 Management Unit

The management area boundaries adopted in this FMP account for the current best understanding of stock structure as well as existing fishing patterns. Additional information on the red crab resource may suggest changes in the management area. In a

similar fashion, as the directed red crab fishery adjusts to direct management, there may be a need to adjust the management area to reflect new fishing patterns.

3.10.2.3 Technical Parameters for MSY

There are several parameters used to develop an estimate of MSY. An estimate of commercial biomass depends upon the size at which adult crabs are considered to recruit to the fishery (be of commercial size), whether crabs landed are males only or include female crabs of the appropriate size, the size of the management area, and the best estimate of the total biomass of red crabs contained within the management area under virgin stock conditions (B_0). Until a robust estimate of the MSY-level fishing mortality rate (F_{msy}) is available, the natural mortality rate (M) is used as a proxy. The current estimate of M used by the Council to determine MSY is based on a range of possible rates of natural mortality available for this species. As the science improves and more detailed information becomes available on this species, better estimates of M may be developed. If the Council receives new or improved information relevant to these parameters, a revision to the estimate of MSY may be warranted.

3.10.2.4 Description and Identification of EFH

Changes to the boundaries of EFH designated for any life stage of red crab may be changed via a framework adjustment if the Council receives new or improved information relevant to the EFH designations and such a change is warranted. Changes to the EFH Text Description may also be made via a framework adjustment.

3.10.2.5 Description and Identification of HAPCs

Changes to the boundaries of any HAPCs designated for any life stage of red crab may be changed via a framework adjustment if the Council receives new or improved information relevant to the HAPC designations and such a change is warranted. New HAPCs may be designated via a framework adjustment for any life stage of red crab if the Council receives relevant information that indicates an HAPC should be considered and the Council approves the proposed HAPC designation.

3.10.2.6 Incidental Catch Limits

Changes to the incidental catch limits established for those fishermen not participating in the directed red crab fishery may be implemented by framework action. This may be necessary if the number of vessels taking incidental catch levels of red crabs changes, or other conditions in the incidental catch fishery change such that the catch limit implemented via this FMP is no longer deemed appropriate. Changes to the overall stock status may indicate that the incidental catch limit should be changed. Better information about the incidental catch fishery and its interactions with the resource and the directed fishery may also indicate appropriate changes to the incidental catch limit. If changes are made through a framework adjustment, they will be within the range identified in this FMP (50 - 1,000 pounds of red crab per trip).

3.10.2.7 Minimum Size of Landed Crabs

If the FMP does not implement a minimum size regulation for the directed red crab fishery, this measure may be implemented by a framework action if it is determined that a regulatory minimum size is necessary. This would most likely occur if the number or proportion of small crabs (females and/or juvenile males) being landed in the directed fishery increases over time and threatens the sustainability of the resource. If the FMP does implement a minimum size regulation, changes to this regulated minimum size may be implemented by a framework action if it is determined that the current minimum size is no longer appropriate. If changes are made through a framework adjustment, they will be within the range identified in this FMP (4" - 5" carapace width).

3.10.2.8 Male Crabs Only

If the FMP does not implement a males-only regulation for the directed red crab fishery, this measure may be implemented by a framework action if it is determined that a males-only regulation is necessary. This would most likely occur if the number or proportion of female crabs being landed in the directed fishery increases over time and threatens the sustainability of the resource. If the FMP does implement a males-only regulation, changes to this regulation may be implemented by a framework action if it is determined that it is no longer appropriate.

3.10.2.9 Butchering/Processing Restrictions

If the FMP does not implement butchering/processing at sea restrictions for the directed red crab fishery, this measure may be implemented by a framework action if it is determined that such restrictions are necessary. This would most likely occur if the number or proportion of undersized and/or female crabs being landed in the directed fishery increases over time and threatens the sustainability of the resource as a result of the butchering and/or processing at sea operations in the directed fishery. If the FMP does implement some form of butchering and/or processing at sea restrictions, changes to these restrictions may be implemented by a framework action if it is determined that the level of restrictions implemented in the FMP is no longer appropriate and either more or less stringent restrictions should be put in place. If changes are made through a framework adjustment, they will be within the range identified in this FMP.

3.10.2.10 Trap Limits

If the FMP does not implement a trap limit for the directed red crab fishery, this measure may be implemented by a framework action if it is determined that trap limits are necessary. This would most likely occur if the number of traps being used in the directed fishery increases over time and threatens the sustainability of the resource or the fishery. If the FMP does implement a trap limit, changes to this regulation may be implemented by a framework action if it is determined that the current limit is no longer appropriate. If changes are made through a framework adjustment, they will be within the range identified in this FMP (400 - 1,000 traps per vessel).

3.10.2.11 Gear Requirements/Restrictions

Escape vents

If the FMP does not implement a requirement for escape vents in the traps used in the directed red crab fishery, this measure may be implemented by a framework action if it is determined that escape vents are necessary. This would most likely occur once sufficient information becomes available to determine the most appropriate dimensions for an escape vent to meet the needs of this FMP. If the FMP does implement an escape vent, changes to this regulation may be implemented by a framework action if it is determined that the current dimensions are no longer appropriate.

Trap size

If the FMP does not implement a maximum trap size restriction for the traps used in the directed red crab fishery, this measure may be implemented by a framework action if it is determined that a maximum trap size is necessary. This would most likely occur if it is determined that members of the directed fishery are increasing their trap size or volume in an attempt to increase their per-trap fishing power. If the FMP does implement a maximum trap size or volume restriction, changes to this regulation may be implemented by a framework action if it is determined that the current dimensions are no longer appropriate.

Trap materials

If the FMP does not implement a restriction on the use of certain materials in the traps used in the directed red crab fishery, this measure may be implemented by a framework action if it is determined that trap materials restrictions are necessary. This would most likely occur if it is determined that the traps being used in the fishery have the potential to cause adverse effects on the habitat of the region or on other species and/or their associated biological communities. If the FMP does implement trap materials restrictions, changes to this regulation may be implemented by a framework action if it is determined that the current restrictions are no longer appropriate.

Trap tags and/or gear markings

If the FMP does not implement requirements for trap tags and/or gear markings in the directed red crab fishery, this measure may be implemented by a framework action if it is determined that trap tags and/or gear markings are necessary. This would most likely occur if trap limits are implemented for the first time in the same framework action, as some form of trap tags and/or gear markings will be a necessary component of any trap limit system. If the FMP does implement trap tags and/or gear marking requirements, changes to this regulation may be implemented by a framework action if it is determined that the current requirements are no longer appropriate, or some modification is necessary to better meet the intent of the regulation.

Trap configuration and deployment

If the FMP does not implement a trap configuration and/or deployment restrictions for the traps used in the directed red crab fishery, this measure may be implemented by a framework action if it is determined that trap configuration and/or deployment restrictions are necessary. This would most likely occur if it is determined that members of the directed fishery are changing their trap configurations in an attempt to increase their per-trap fishing power. If the FMP does implement a trap configuration and/or deployment restriction, changes to this regulation may be implemented by a framework action if it is determined that the current restrictions are no longer appropriate.

Ghost panel

If the FMP does not implement a requirement for ghost panels in the traps used in the directed red crab fishery, this measure may be implemented by a framework action if it is determined that ghost panels are necessary. This would most likely occur once sufficient information becomes available to determine whether or not the current practices in the fishery and current trap designs are sufficient to prevent undue levels of ghost fishing from lost or broken traps. If the FMP does implement a ghost panel requirement, changes to this regulation may be implemented by a framework adjustment if it is determined that the current dimensions or specifications are no longer appropriate.

Marine mammal requirements

Most changes to gear requirements intended to comply with marine mammal requirements are implemented through the Atlantic Large Whale Take Reduction Plan (ALWTRP). If specific measures that only apply to the directed red crab fishery are deemed necessary or appropriate, these measures may be implemented by a framework adjustment to the Red Crab FMP.

Prohibition on the use of parlor traps

If the FMP does not implement a prohibition on the use of parlor traps in the directed red crab fishery, this measure may be implemented by a framework action if it is determined that this prohibition is necessary. This would most likely occur if it is determined that members of the directed red crab fishery are using redesigned crab traps that employ parlors, and the new gear has the potential to cause adverse effects on the red crab resource. If the FMP does implement a prohibition on the use of parlor traps in the directed red crab fishery, changes to this regulation may be implemented by a framework action if it is determined that the current restrictions are no longer appropriate.

Prohibition on the use of other gear types

If the FMP does not implement a prohibition on the use of fishing gear types other than traps in the directed red crab fishery, this measure may be implemented by a framework action if it is determined that this prohibition is necessary. This would most likely occur if it is determined that members of the directed red crab fishery are migrating to other gear types, such as otter trawls or dredges, that have the potential to cause

adverse effects on the red crab resource, the habitat of the region, or on other species and/or their associated biological communities. If the FMP does implement a prohibition on the use of fishing gear types other than traps in the directed red crab fishery, changes to this regulation may be implemented by a framework action if it is determined that the current restrictions are no longer appropriate.

3.10.2.12 Total Allowable Catch

Most management alternatives under consideration by the Council in the development of this FMP include some form of TAC established for the directed red crab fishery, either a hard TAC that establishes the upper limit of landings for the year, or a target TAC that serves as a guide for other effort-based controls on the fishery. Changes to the annual TAC may be implemented by framework adjustment or through an annual specifications process. These changes are likely to occur on an annual basis as part of the "annual adjustment" for this fishery. Each year, the Council will monitor landings and determine if the current year's landings are likely to exceed the TAC, as well as whether the TAC established remains appropriate as we learn more about the resource and the stock status.

In any year that the fishery exceeds a hard TAC, the amount of the overage will be deducted from the following year's TAC. In any year that the fishery is projected to exceed a target TAC, the amount of the projected overage will be deducted from the following year's target TAC. New information on the status of the stock may indicate that previous or current TACs are either too high or too low. Such information would be used to adjust the following year's TAC.

Depending on the information available to the Council, it may be appropriate or necessary to modify the method used to determine the annual TAC. If changes are made to this process through a framework adjustment, they will be within the range identified in this FMP. If the FMP does not implement a TAC for the directed red crab fishery, this measure may be implemented by a framework adjustment if it is determined that a TAC is necessary. This would most likely occur if it is determined that the current controls on the fishery are insufficient to adequately control landings to a sustainable level and a more direct control on landings is necessary to prevent overfishing.

3.10.2.13 Possession/Trip Limits

If the FMP does not implement trip limits for the directed red crab fishery, this measure may be implemented by a framework action if it is determined that some form of trip limits are necessary. This would most likely occur if the per trip fishing power of vessels participating in the directed fishery increases out of proportion with the other effort controls in the fishery, such as if vessels convert to butchering or processing at sea to improve their overall per trip landings. If the FMP does implement some form of trip limits in the directed red crab fishery, changes to or elimination of these limits may be implemented by a framework action if it is determined that the existing trip limits are no longer appropriate and either more or less stringent restrictions should be put in place.

If the trip limit is not eliminated, but changes are made through a framework adjustment, they will be within the range identified in this FMP (10,000 - 200,000 pounds per vessel per trip). Following sufficient time during which detailed and complete information on the directed red crab fishery has been collected, it may be appropriate to implement new methods for setting the trip limits to which each vessel participating in the fishery is subject. For example, the Council could use vessel average per trip landings or maximum per trip landings to establish trip limit categories for the vessels in the directed fishery.

3.10.2.14 Controlled Access System

Most management alternatives under consideration by the Council for the Red Crab FMP include some form of controlled access system to determine participation in the directed fishery. Changes to this controlled access system may be implemented by a framework adjustment if these changes are warranted. Most likely, changes to the controlled access system would be used to increase the number of vessels authorized to participate in the directed fishery if new information indicates that this increase is appropriate and would not threaten the sustainability of the resource or the existing fishery. If the FMP does not implement some form of controlled access system for the directed red crab fishery, a framework adjustment will not be the appropriate mechanism to implement a new controlled access system should the Council determine that such a system is necessary and appropriate.

3.10.2.15 Days-at-Sea Limits

If the FMP does implement some form of days-at-sea limits in the directed red crab fishery, changes to these limits may be implemented by a framework action if it is determined that the existing DAS limits are no longer appropriate and either fewer or additional DAS should be allocated to either the fleet or to individual fishing vessels. For example, each vessel will be allocated a percentage of the overall fleet DAS, which are determined based on the annual target yield (or target TAC) and an assumed fleet average catch per day-at-sea. If the target yield changes, either as a result of new or updated information on the status of the resource or as a result of the projected utilization of previous years' or current year's target TACs.

As we collect more information on the operations of the directed red crab fishery, we may be able to calculate a more robust estimate of the fleet average landings per day-at-sea. As our estimate of this estimate changes, the fleet DAS will also be adjusted. One last way in which the vessels' allocation of DAS may change is if the number of vessels participating in the directed fishery changes, either through attrition or through a change in the controlled access system. If changes are made through a framework adjustment, they will be within the range identified in this FMP (11 - 296 DAS per vessel per year). If the FMP does not implement some DAS program for the directed red crab fishery, a framework adjustment will not be the appropriate mechanism to implement a new DAS program should the Council determine that such a system is necessary and appropriate.