

with landings during this time frame. Of these fourteen vessels, four had less than 1,000 pounds of red crab landings and seven had less than 10,000 pounds. Of the remaining seven vessels, different numbers of vessels could potentially qualify for the controlled access program depending on the specific criteria selected. Refer to Table 18 to see the minimum number of vessels that would be expected to be able to qualify under each of the controlled access criteria for the one year following the control date.

Although potentially less restrictive than the options for the criteria for landings prior to the control date, this option is at least more straight forward. Only one year's worth of landings would be considered, so there are no contingencies for a multi-year average or looking at the maximum or minimum landings during a multi-year time period. Depending on the minimum landings weight criterion selected, between four and seven vessels would be expected to qualify. As noted above, these numbers represent the *minimum* numbers of vessels only, as additional vessels may be able to present information on landings not currently reflected in the NMFS VTR and/or dealer weighout databases. Again, as noted above, the Council considered adopting the most restrictive criterion that provides the same number of vessels (e.g., 250,000 pounds instead of 200,000 pounds -- both of which would allow at least five vessels to qualify).

5.3.9.2 Biological and Ecological Impacts of the Measure on Red Crab

The direct biological and ecological impacts on the red crab resource expected as a result of this potential measure are limited to the potential affects associated with the number of vessels prosecuting the directed fishery. This measure is solely concerned with the number of vessels qualified to participate in the directed red crab fishery. From biological and ecological perspectives, the number of vessels prosecuting the fishery may be irrelevant. Other measures, such as those that control overall landings, would be expected to more directly affect the resource. For example, if the controlled access program had been devised to allow 17 vessels access to the directed fishery, but each vessel is limited to an annual harvest of 320,000 pounds, then the total harvest would be less than 5.5 million pounds. If, on the other hand, the controlled access program was devised to limit the fishery to four vessels, but those vessels have no TAC or trip limit or other effort control, and each of the four vessels makes 30 trips at an average of 65,000 pounds per trip, then the fleet would be expected to harvest 7.8 million pounds.

However, there may be indirect impacts associated with this measure related to the timing of the harvest activity. Mating and reproduction could be affected by the number of vessels participating in the fishery if their fishing effort is condensed in time. For example, the more vessels participating in the fishery, the more likely that a majority of the overall target yield will be harvested early in the fishing year (this would be exacerbated under any conditions which fail to prevent derby-type fishing, such as a hard TAC alone). If the fishery is constrained to landing only large male red crabs, the removal of a significant portion of this segment of the population during a short time could have repercussions for the whole population. Under a scenario of a large fleet operating under a hard TAC, most of the large males could be removed from the population *before* they have had a chance to mate that year. Thus, the reproductive cycle for that year would be wholly dependent upon small males, who may be less successful.

5.3.9.3 Ecological Impacts of the Measure on Other Species and Communities

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

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

5.3.9.4 Impacts of the Measure to Essential Fish Habitat

Overall, this fishery is not considered to contribute any adverse impacts to the habitat of the region and this measure does nothing to alter this conclusion. This measure will be used to determine the number and which fishing vessels qualify to participate in the controlled access directed red crab fishery. Limiting the number of vessels participating in the fishery does have an impact on the level of fishing effort, but since the fishing activities associated with this fishery do not have any known adverse impacts to the EFH of any managed species, constraining overall fishing effort, as represented by the number of participating vessels, does not decrease or increase any impacts to habitat.

5.3.9.5 Economic Impacts of the Measure on the Fishery

A controlled access program limits the participation of vessels in the fishery; it does not directly limit the catch of fish. Limited access alone is not sufficient to provide the incentives for proper management of the red crab stock. The controlled access system establishes qualification criteria based on history in the red crab fishery. The intent of this system is to ensure that participation in the red crab fishery is maintained at sustainable levels.

As an alternative to a straight in-or-out access program (where vessels either get total access or no access to the directed fishery), the Council considered adopting a program of differentiated access for vessels to qualify for different levels of participation based on their history in the fishery. The Council would develop categories (e.g., occasional, part-time, and full-time, or seasonal access to the directed fishery as well as full-time access) and allow vessels different levels of participation according to the category qualification criteria. Many options could be used to either establish the criteria just for access to the fishery (without categories) or to determine in which category each qualified vessel would fit.

This measure was written with a high degree of flexibility and a wide range of potential criteria to establish a controlled access program. The factors to be decided included whether or not to use the control date established, the time period prior to or

after the control date, the amount of qualifying landings, as well as how landings would be compared against the time frame. Refer to Table 17 to see the minimum number of vessels that would qualify under each set of controlled access criteria, if using landings prior to the control date of March 1, 2000. Refer to Table 18 to see the minimum number of vessels that would qualify under each set of controlled access criteria, if using landings for one year subsequent to the control date (March 1, 2000 - February 28, 2001). In reviewing Table 17 and Table 18, it can be seen that many of the possible options have an overlapping number of vessels that would qualify. The number of qualifying vessels range from three (most restrictive) to eight (least restrictive). These numbers, again, represent the minimum number of vessels only, as additional vessels may be able to prove participation in the fishery according to the established criteria.

The preferred alternative includes a controlled access program where vessels must demonstrate that their average annual landings of red crabs during the three years prior to the control date (March 1, 1997 – February 29, 2000) were greater than 250,000 pounds. This option would allow for five vessels to participate in the directed fishery (see Table 17). During that three year period, eight out of 30 vessels could have qualified under less restrictive criteria. This means that there are three vessels that are not expected to qualify for the controlled access program that would have qualified had other criteria been preferred. For example, if the criteria, using that same three years prior to the control date, had been that vessels must have a total of at least 40,000 pounds for the three years, eight vessels would have qualified. Clearly, a total of 40,000 pounds for three years is a significantly different criterion than an average of 250,000 pounds over three years. More attention will be given to a description of these vessels and what was done to mitigate the impact on them.

The preferred alternative implements the March 1, 2000 control date. Without the control date, additional vessels may have qualified under different criteria. As an indication of interest in the fishery, 17 vessels requested letters of authorization (LOAs) from the NMFS Regional Administrator to allow them to harvest more than 100 pounds of red crab per trip during the first emergency rule period, May 18 - November 14, 2001. However, out of seven vessels that landed red crab, only six made multiple trips during the emergency period and consistently landed at or near the trip limit. The 17 vessels that requested LOAs could be taken as an upper limit when calculating those vessels that did not qualify for controlled access. This would imply a potential of 12 vessels that will not qualify had other criteria been selected (such as under the no action alternative).

Using the control date as a mechanism to establish history in the fishery requires the development of qualification criteria that are fair and equitable, the development of a mechanism to demonstrate that these criteria are met, and the establishment of an appeal and resolution process for those vessels denied access to the fishery.

This measure is solely concerned with the number of vessels qualified to participate in the directed red crab fishery. If this were the only measure included in the plan, it would not limit the total harvest enough to protect the resource for the future. The intention of this option would be to differentiate full-time directed red crab vessels from those vessels occasionally targeting red crabs.

One option of controlled access would give those vessels currently and actively fishing for red crab access to the directed red crab fishery under the FMP. New vessels not currently in the fishery would not necessarily be given access to the fishery unless there was capacity remaining. The difficulty with this option will be to define “currently.” One method for determining the number of vessels in the fishery is to use the number of vessels that requested LOAs from the Regional Administrator during implementation of the red crab emergency regulations. Alternatively, the six vessels that made multiple trips under the first emergency action period may be thought to be those currently and actively fishing. This would imply that the preferred alternative would omit only one vessel from the directed fishery. From the public comments, there is clearly at least one vessel on record that would be eliminated from the future fishery.

A vessel size restriction was considered to establish an upper limit on the size of vessels that may participate in the directed red crab fishery. The size restriction could be based solely on registered length (e.g., a maximum of 120 feet), on hold capacity (e.g., a maximum of 100,000 pounds) or on some combination of vessel specifications. The hold capacity of a vessel would be the determining factor in how many pounds of red crab it could land before returning to port. Vessel lengths vary from 72 feet to 150 feet with an average of 105 feet. The hold capacity varies from 60,000 pounds to 320,000 with a mean of 122,000 pounds.

The most significant factor contributing to the immediate threat of overfishing the red crab resource derives from the addition of several new vessels into this fishery in late 2000 and early 2001. The capacity of the additional vessels, in combination with the capacity of the existing vessels, likely exceeds the capacity needed to harvest this resource at sustainable levels. One potential argument is that controlled access will discriminate against potential new entrants. In reality, their only loss is the opportunity to share capital gains accruing to those that were grand-fathered (or allowed in because of the control date) into the fishery.

Depending on the degree of controlled access allowed in the FMP, it is possible some processors may be affected. If a vessel were not allowed into the fishery under the FMP, then the processor(s) that had purchased product from that vessel would no longer be able to buy that product, unless they bought product from another vessel. All processors remain free to purchase from another source under all of the alternatives considered for the FMP. The loyalty between vessels and processors may make that somewhat difficult although still possible. Respondents to the survey indicate that most vessels use only a single processor, although one respondent did report occasionally using a second. Most respondents indicated that they choose to sell their red crab to a particular processor in large part out of loyalty to that processor. If a processing plant were to lose business because of a vessel’s absence in the fishery, their profits would suffer. However, all of the processors report relying on some other products in addition to red crab. On average, red crab accounts for 11.5% of their fishery-related processing operations. Most processing employees work either on other fishery-related products or at least do not work exclusively on red crab. See Appendix B for a further discussion of the processing sector.

There are no measurable economic impacts to fishery-dependent service industries expected as a result of controlled access. If a current vessel is prohibited from entering the fishery, the supplier of services to that vessel would be impacted. It is unknown to what extent, because we do not know to how many vessels the suppliers sell. The current suppliers of these types of services presumably would not experience any change in their service level when selling to vessels qualified under the controlled access program.

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

5.3.9.6 Social/Cultural Impacts of the Measure

The specific issues identified in the Magnuson-Stevens Act for consideration when developing any form of limited or controlled access relevant to an assessment of potential social and/or cultural impacts include: the cultural and social framework of the fishery and the fishing communities; the present and historical participation in and dependence on the fishery; and the capability of vessels in the fishery to engage in other fisheries.

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

As discussed elsewhere in the this FMP (see the Background and Purpose section for an overview), the historical and present participation in this fishery are markedly different. The present participation can probably best be characterized by the levels of participation during the emergency rule period, May 18 - November 14, 2001. Seventeen vessel requested letters of authorization (LOAs) from the NMFS Regional Administrator, allowing these vessels the ability to harvest and retain more than 100 pounds of red crab per trip. This number of vessels could be considered as representative of the current level of interest in the fishery. Another approach to defining the present participation in the fishery is to identify the number of vessels that participated in the emergency rule fishery at a level consistent with a directed fishery. There were six vessels that made multiple trips during the emergency period and consistently landed at or near the trip limit.

Historically, fewer vessels have been involved in the fishery at significant levels. As indicated in the above analysis, there were only five vessels that averaged more than

250,000 pounds per year in the three years prior to the control date, and only two vessels that had at least 300,000 pounds in each of the three years prior to the control date. At least two of the vessels that participated in the emergency period red crab fishery at directed fishery levels had not participated in the fishery prior to 2001.

The social impacts associated with participation levels derive from a vessel's ability (and the people associated with and dependent upon that vessel) to continue to participate in the fishery, or to find other suitable alternatives that are not disruptive to their social networks. In the case of the directed red crab fishery, implementation of a controlled access program is likely to primarily affect the vessels that entered the fishery in 2001. The qualification criteria proposed by the Council (see Table 17) would allow at least five vessels to continue to participate.

The two recent entrants, and other vessels that have not participated in the directed fishery at significant levels, may not be authorized to participate in the directed fishery following implementation of this FMP. However, the impacts to these vessels are expected to be much less significant than they would be on the vessels that have participated in this fishery at significant levels for longer periods of time. The two new entrants had been participating in other fisheries in other parts of the country prior to entering the red crab fishery in 2001. They entered the red crab fishery after the publication of the control date and the notice that the Council would be considering a limited entry program and would consider landings after the control date differently from landings prior to the control date; thus, they entered this fishery fully aware that they may not be allowed to continue to participate once an FMP was developed.

The vessels that have not traditionally participated in the red crab fishery at directed levels appear to either be part-time fishing vessels or they have other primary fisheries. These vessels may be prohibited from participating in the red crab fishery at directed levels, but they will be allowed to continue to land red crab at the level of the incidental catch limit. For some of these vessels, this will result in no change to their current fishing practices, but others may be required to cut back on some amount of their landings. Please see the analysis under the proposed incidental catch limit measure (Section 5.3.1.5) for a full description of the potential social impacts of this action.

Once the vessels authorized to participate in the directed red crab fishery are known, this should improve the stability felt by the fishermen associated with these vessels and their families. Similarly, the uncertainty should decrease as these fishermen will know that they can continue to participate in the directed fishery. The flexibility of these vessels will remain unchanged. For the vessels who would otherwise wish to participate in the directed fishery, but will not qualify under the selected options, the stability and flexibility would be expected to decrease and uncertainties would increase. These variables would reflect increased levels of social impacts to these fishermen.

One issue to note is that there is general support for a controlled access program in the directed fishery, so this measure should be well-supported by the industry. Of course, those vessels that may be excluded from the fishery will most likely no longer support the measure. It must also be recognized that the Council announced its intent to consider a

controlled access program early in 2000, with the publication of a control date to differentiate new entrants in the fishery from established ones. Anyone entering the fishery after this control date should have recognized the possibility that they would not be allowed to participate in the directed fishery once an FMP was implemented. This knowledge may not eliminate potential social impacts to the fishermen associated with these vessels, but it should have prepared them to appropriately mitigate the impacts.

This proposed measure is not expected to have any effect on the occupational opportunities of any participants of the directed fishery, except as identified above. The proposed measure is not expected to have any effects on community infrastructure, or the safety of any fishery participants.

5.3.9.7 Impacts of the Measure on Protected Species

Controlling participation in the fishery to sustainable levels would be expected to have a direct beneficial effect on marine mammals and other protected species. The proposed criteria for past participation in the red crab fishery to qualify for a controlled access permit under the Red Crab FMP will restrict the fishery to a level of vessel participation that can be expected to maintain effort at historic levels. Therefore, the proposed measure is not likely to increase the existing entanglement threat to protected species.

5.3.10 **Days-at-Sea Limits**

Overview

This measure establishes a days-at-sea (DAS) program for the controlled access directed red crab fishery, constraining vessels participating in the directed fishery from fishing for red crab to the allocated number of annual DAS. The DAS program will serve as the principle fishing effort control mechanism by limiting the amount of time (i.e., the number of days) that an authorized red crab fishing vessel may spend at sea each year in the directed harvest of red crabs. All time away from port would be counted against each vessel's annual DAS allocation, so steaming time is included and counted as a day-at-sea.

Calculation of DAS

There were several steps necessary to develop and analyze this potential measure. One of the first steps was to determine how many total days the fleet should be allocated. This amount will later be distributed among the authorized fishing vessels in a manner that will determine the per vessel DAS allocation. The total fleet DAS should be calculated to reflect the total amount of fishing effort that would equate to an annual harvest equal to the target yield.

In order to determine how many DAS the entire fleet should be allocated, the approximate "value" of each average fishing day should be calculated. This should be based on records of actual landings on trips of known duration. If there are enough records of landings and trip lengths for the vessels in the fleet, a relatively robust fleet average can be calculated.

Using data collected by NMFS during the emergency period, we should be able to calculate an average catch per day that can be attributed to the fleet overall. Dividing the target annual yield by this average catch per day results in the total number of DAS that should be available to the fleet. Out of a total of 52 trips made during the emergency period (as reported in the IVR database), only 22 were represented in the VTR database as of the time this document was prepared. Table 19 provides a summary of the trip landings, length, and landings per day of trip from the red crab emergency period for these 22 trips (the VTR data are required for this analysis in order to calculate trip length).

Emergency Period Landings (n = 22, as of 1/03/02)	
Average landings per trip	53,271 pounds
Average length of trip	8.14 days
Median landings per day of trip	6,671 pounds
Mean landings per day of trip	6,798 pounds
95% CI minimum	6,001 pounds
95% CI maximum	7,594 pounds
20% Trimmed Mean landings per day	6,782 pounds
Mean of vessels per day of trip	6,488 pounds

Table 19: Analysis of vessel trip report data from red crab emergency period, May 18 - November 14, 2001 (data available as of 1/03/02).

This suggests that each day that a red crab fishing vessel is at sea (including steaming time) they can catch an average of approximately 6,800 pounds of marketable red crabs, or at least that the range is between approximately 6,000 pounds and 7,600 pounds of landings per day. Of course, this information is fairly limiting due to the small sample size. As more data from this fishery become available, these figures can be recalculated with larger sample sizes.

When more data are available in the VTR database (or at least a more significant percentage), there are several variations of this analysis that can be done. First we can compare the catch per day of the larger vessels compared to the smaller vessels. We can also compare the catch per day of the vessels that process or butcher compared to the vessels that land whole crabs. Differences in productivity can be identified for individual vessels, size category of vessel, and product category of vessels.

Once the Council decided on a target yield, these amounts were compared to the best estimates of landings per day to determine the fleet annual DAS. For example, if we assume that the range of MSY estimates provided in Table 8 represents the extremes of the target yield for the fishery, we can calculate an estimated fleet DAS for each endpoint of this range. Then, for each controlled access scenario used in the FMP analysis, we can specify how many DAS each vessel would be allocated, assuming equal allocation of days.

Target Yield = OY (OY = 95% of MSY)			
Estimates of OY (in pounds)	1.254 million	5.928 million	7.904 million
Total Fleet Annual DAS	188	888	1,185
Per Vessel DAS with 4 Vessels	47	222	296
Per Vessel DAS with 5 Vessels	38	178	237
Per Vessel DAS with 6 Vessels	31	148	197
Per Vessel DAS with 17 Vessels	11	52	70

Table 20: Speculative number of potential DAS to be allocated to red crab fishing vessels, based on preliminary analysis and using the median landings per day-at-sea.

This suggests that under this scenario (target yield = OY), if there are five vessels authorized to fish for red crab in the directed fishery, each vessel would be allocated between 38 and 237 DAS for the year; assuming the MSY calculated for the red crab resource (6.24 million pounds, such that OY=5.928 million pounds), each of the five vessels would be allocated 178 DAS. All vessels would be required to notify NMFS when they embark on a fishing trip and when they return. They would also be required to report all landings to NMFS. Once they have used their allocation of DAS, they would not be allowed to fish for or possess more than the incidental catch level of red crab. At the end of each year, the total landings would be calculated and compared against the target yield. If the target yield was exceeded, each vessel would be allocated fewer DAS the following year. If the landings were less than the target yield, each vessel could be allocated additional DAS for the following year.

Once we have additional data on which to base these analyses, including an analysis of productivity by categories of vessels, we should have enough information to determine the appropriate number of DAS to be allocated to the fleet. Depending on the outcome of these additional analyses, it may be appropriate to allocate different numbers of DAS to different categories of vessels.

In the first year of FMP implementation (through February 28, 2003), each vessel authorized to participate in the controlled access directed fishery will be allocated a percentage of 130 DAS. 130 DAS is the baseline allocation for all vessels in the first year of FMP implementation, but this baseline will be adjusted to account for estimated landings that occur between May 15, 2002 and the date the red crab controlled access 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. 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.

Allocated DAS in Year 1

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 estimate the amount of landings from any hiatus period based upon the best available data and projections. The Regional Administrator will also 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 will 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 will 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, in this example this would be for 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.

5.3.10.1 Biological and Ecological Impacts of the Measure on Red Crab

A days-at-sea allocation alone is unlikely to have any direct effects on the red crab resource. The options proposed in this measure constrain the fishing power of individual

vessels to a certain number of fishing days per year, but do not necessarily constrain the fishing power of the entire fleet, which will be dependent upon the specifics of the controlled access program and the number of vessels authorized to participate in the directed fishery.

For example, assuming an average landings of 6,500 per day at sea, if there are 10 vessels each authorized 200 DAS per year, the fleet would be expected to harvest on the order of 13 million pounds of red crab. If, however, five vessels are each authorized 170 DAS per year, this fleet would be expected to harvest on the order of 5.5 million pounds. The DAS program is intended to be based on the overall yield expected from the resource (see the discussion under the TAC measure) and the number of vessels authorized to participate in the directed fishery (see the discussion under the controlled access measure), assuming some average landings per DAS.

5.3.10.2 Ecological Impacts of the Measure on Other Species and Communities

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

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

5.3.10.3 Impacts of the Measure to Essential Fish Habitat

This measure, which proposes to allocate a certain number of days during which a red crab vessel may fish for red crab, would have no direct effect on the level of fishing effort in the directed red crab fishery. The acceptable level of fishing effort will be determined by the establishment of an allowable level of catch. The DAS options simply provide a mechanism to allocate the allowable fishing effort amongst the participating fishing vessels. In addition, overall this fishery is not considered to contribute any adverse impacts to the habitat of the region and this measure does nothing to alter this conclusion.

5.3.10.4 Economic Impacts of the Measure on the Fishery

A decrease in effort always results in a short-term decrease in catch rate, but importantly, may lead to an increase in the long term. In standard yield-effort relationships, the short-term catch rate will always increase with increasing levels of effort. It is only over the long term, when the process of population dynamics has resulted in decreased fish stock, that yield will ultimately decline. The use of days-at-sea as a management option would allow more continuity of effort and supplies to the

market, and avoids any response to short term fluctuations.

Days-at-sea (DAS) limits as a sole measure may be effective if the days are allocated to individual vessels and not to the fleet. Also, the initial allocation of DAS must be significantly low to allow for recovery of the stock. DAS limits for the directed red crab fishery would be used in conjunction with a target TAC to prevent a derby fishery. The days-at-sea program will be adjusted annually depending on how the fishery is doing against the annual TAC. The initial total DAS available to the fishery will depend upon many factors, including the initial TAC, the number of vessels, and other effort controls implemented through the FMP, such as trap limits and/or trip limits. One of the benefits to the fishermen of the DAS program is that they have greater flexibility in decisions about when and how long to fish. This would help them to operate each trip as efficiently as possible, and to space their landings optimally to take advantage of market conditions.

The DAS measure is written with a high degree of flexibility and a wide range of potential criteria to allocate DAS. The potential flexibility would allow a choice between equal allocation of DAS without regard to the vessel's history in the fishery or past landings, allocation of DAS on a sliding scale based on the history of the vessel in the fishery, or allocation of DAS on a sliding scale based on landings of red crab reported over a specified time period. Vessels with higher landings could be allocated proportionally more DAS than vessels with lower landings. There may be various degrees of end-of-year carry-over of unused DAS or none at all allowed.

The preferred alternative selected by the Council would allocate DAS equally to all vessels authorized to participate in the controlled access fishery. All vessels authorized to receive a controlled access red crab permit must, on an annual basis, declare their intent to participate or not in the directed fishery for the next fishing year at least six months prior to the start of the fishing year. This will allow the annual allocation of DAS to be calculated based on the actual number of participants in the fishery. The small number of vessels in the fishery means that each vessel's participation has a large impact on the appropriate number of DAS that the fleet will utilize in catching the target TAC. The advance knowledge and planning for efficient harvest will have economic benefits from harvesting to processing to marketing. Public comments supported this declaration of intent.

Depending on the total number of days at sea allocated, and the manner in which they are allocated in the FMP, it is possible some processors may be affected. If the DAS allocated per vessel is significantly less than the vessel's usual pattern (which appears likely, as would be the case under the preferred alternative), the short term supply to their processor(s) may be affected. However, since a DAS program promotes a twelve month fishery, the processors supply should be steady, if limited. If a vessel were not allowed into the fishery under the FMP, then the processor(s) that that vessel has sold to would no longer have that product available for purchase. Respondents to the survey indicate that most vessels use only a single processor, although one respondent did report occasionally using a second. However, all of the processors report relying on some other products in addition to red crab. On average, red crab accounts for 11.5% of their fishery-related

processing operations. Most processing employees work either on other fishery-related products or at least do not work exclusively on red crab. See Appendix B for a further discussion of the processing sector.

There may be minimal economic impacts to fishery-dependent service industries expected as a result of a days at sea measure. If a vessel were not allowed into the fishery under the FMP, then the service industries that provided that vessel with services, would no longer be getting the same business from that vessel. It is impossible to speculate on what that vessel may do under those circumstances, and whether or not he would still need those same service industries.

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

5.3.10.5 Social/Cultural Impacts of the Measure

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

The DAS measure is proposed primarily as a way to control the overall amount of fishing effort (as in the TAC options), but with a much higher level of certainty and flexibility afforded the individual fishermen. The DAS measure will be paired with a target TAC, as opposed to a hard TAC where the fishery is closed upon the TAC being reached. The target TAC will be used to measure how closely the allocated number of DAS matches the anticipated overall catch level. Total landings may vary, but should vary around a mean very close to the target yield for the fishery.

The increased flexibility to the fishermen results from the ability of the fishermen to choose when and for how long to fish, depending on weather, market considerations, availability of crew, etc. The fishermen will be allocated a certain number of DAS, which they can use at any time during the fishing year. Increases in stability would be expected as the fishermen can plan their use of their DAS, and they will know exactly how many days they can fish each year. Both of these factors will reduce the uncertainty normally felt by fishermen unsure of when the fishery may close due to harvest levels.

There would be no reason to anticipate any derby-type fishing occurring, as there is no incentive to “race to fish.” Occupational opportunities would not be expected to

change as a result of this measure, and may, in fact be improved from those associated with the simple hard TAC measure. Any reduction in occupational opportunities would result from an overall reduction in target yield from current landings levels, but this cannot be linked to this measure, which is proposed as a mechanism to match fishing effort with the available yield.

The proposed measure is not expected to have any effects on community infrastructure, or the safety of any fishery participants. There appears to be general support for this type of measure among the participants in the directed fishery, although most are somewhat hesitant until they know the actual number of DAS they are likely to be allocated.

5.3.10.6 Impacts of the Measure on Protected Species

Days-at-sea limits will not by themselves reduce red crab fixed gear effort. However, the proposed TAC level described above will cut the total landings back to 1999 levels. This represents a 25% reduction in landings (and presumably overall fishing effort) from 2001 levels. DAS limits set between 130 and 160 will allow the small number of vessels that will qualify for controlled access permits to fish for most of the fishing season. The proposed measure is not likely to increase the existing entanglement threat to protected species.

5.3.11 **Individual Vessel Quotas**

This non-preferred measure proposed managing the directed red crab fishery by allocating a portion of the overall available quota to each vessel authorized to participate in the directed red crab fishery. Although this measure cannot currently be adopted by the Council due to a Congressional moratorium against all new individual fishing quota programs, it is presented here for the sake of comparison.

5.3.11.1 Biological and Ecological Impacts of the Measure on Red Crab

The potential biological and ecological impacts of this proposed measure are exactly the same as in the measure proposing an overall TAC for the fishery. The principal difference between these two measures is that this measure proposed to allocate a specific amount or percentage of the overall TAC to each vessels participating in the directed red crab fishery, whereas the TAC measure simply dictated what the overall yield for the fishery should be. As long as the vessel quotas are adhered to and the overall quota is set appropriately, the risk to the resource of overfishing will be minimized. As in the TAC measure, the risk to the resource increases as the amount of the overall quota increases. The risk to the resource also increases if all the vessels harvest more than their allotted share of the quota and the overall quota is exceeded.

5.3.11.2 Ecological Impacts of the Measure on Other Species and Communities

Very little is known about the interactions of the deep-sea red crab with other species and their associated communities. The directed red crab fishery has no known interactions with other species or their associated communities, as the bycatch of other

species in the red crab fishery is minimal. The impacts of this fishery on other species or their communities are expected to be minimal to non-existent. This proposed measure would not affect this conclusion.

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

5.3.11.3 Impacts of the Measure to Essential Fish Habitat

This measure, which simply proposes to allocate portions of the overall allowable catch of red crabs to particular participants in the directed red crab fishery, would have no effect on the habitat of the region. This measure would not change the overall level of fishing effort, nor would it affect the distribution of fishing effort. In addition, overall this fishery is not considered to contribute any adverse impacts to the habitat of the region and this measure does nothing to alter this conclusion.

5.3.11.4 Economic Impacts of the Measure on the Fishery

Assuming that the current moratorium is lifted at some point in the future, an IVQ system should be considered.

In addition to granting the right to be in the fishery, individual quotas also convey the right to harvest a specified quantity to fish (or proportion of TAC). Since it works back from a predetermined TAC to the amount available to the individual vessel, it provides much tighter control over each year's catch than would control of inputs (such as DAS or trip limits). They would also allow a greater degree of freedom to the individual fisherman. His choice of area or fishing time would be his own. There is no incentive to over invest in the vessel and gear, or to select anything but the least cost combination of inputs. An IVQ system could be developed that would assign an annual quota to each vessel qualified to fish in the directed red crab fishery based on their annual landings during some qualification time period (for instance the year prior to the control date). Thus, if a vessel landed 100,000 pounds of red crab in the year prior to the control date, they would be allocated an annual quota of 100,000 pounds or else a percentage based on their vessel history. Depending on the number of vessels granted the right to be in the fishery, this program may allow vessels to continue to fish at previous levels but perhaps not to expand their effort in the fishery.

A variation of this measure would be to first qualify the vessels that may participate in the directed fishery (via a controlled access program) and then to allocate quota to all qualified vessels equally, regardless of differences in history in the fishery or prior landings. Thus, if five vessels qualify to participate in the controlled access directed fishery, each vessel would be allocated 20% of the annual quota. This would have equity implications and would not reward anyone for their prior fishing activity.

To be an effective tool, IVQs must be tailored to the circumstances that exist in the

red crab fishery and the goals to be achieved. Given the dynamic nature of fishing activities, it is likely that management of IVQs will require flexibility to stay abreast of social and economic changes. A quota-based management system may be able to achieve the goals of the FMP in a consistent basis because it directly limits the amount of catch. As with other quota systems, the success of the program would depend on the appropriate level of the catch limit. Some argue that the incentives built into an IVQ system make them effective because the value of the IVQ depends upon the health of the stock. Some potential negative impacts of an IVQ system are the high management requirements and behavior among participants that may not be in the best interest of the stock (such as high-grading). These problems would appear to exist in whatever manner fisheries are managed. IVQs are well suited to shellfisheries where the problems of multi-species fisheries do not exist. There is also not much bycatch to create a problem.

The use of IVQs would allow the most flexibility for harvesters as well as the processors to which the vessels choose to sell. Respondents to the survey indicate that most vessels use only a single processor, although one respondent did report occasionally using a second. Most respondents indicated that they choose to sell their red crab to a particular processor in large part out of loyalty to that processor. Since IVQs may be paired with a controlled access system, the comments made in that section would apply in this case. See Appendix B for a further discussion of the processing sector.

There are no known economic impacts to fishery-dependent service industries expected as a result of IVQs. Again, if a controlled access system is paired with an IVQ, those comments will also apply. The current suppliers of these types of services would handle any change in services needed, but it is the absence of vessels that may affect the business of these suppliers. If vessels are eliminated under a controlled access program, the suppliers of those vessels may or may not be able to still supply them with their product, depending on what the vessel did as an alternative.

An IVQ program would enable vessels to operate in an efficient manner. They would essentially be able to fish in a manner that they are used to fishing, with full knowledge of what lies ahead. Any change, which has an effect on the efficiency of red crab vessels, will in turn have an effect on the markets. It is unknown what impact this efficiency would have on the markets.

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

5.3.11.5 Social/Cultural Impacts of the Measure

There are no data available with which to evaluate the potential impacts of this measure on the social and cultural aspects of New England and Mid-Atlantic fishing communities. The small size, few participants, and distributed nature of this fishery, however, suggests that any social or cultural impacts to these fishing communities will be negligible. Based on information provided by members of the red crab fishing industry

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

The IVQ measure is proposed primarily as a way to control the overall amount of fishing effort (as in the TAC options), but with a much higher level of certainty and flexibility afforded the individual fishermen. The proposed IVQ system would be based on an overall TAC for the fishery, but rather than creating incentives for a race to fish, each vessel would know a priori the amount of the overall TAC they are authorized to harvest. Total landings should never exceed the target yield for the fishery.

The increased flexibility to the fishermen results from the ability of the fishermen to choose when and for how long to fish, depending on weather, market considerations, availability of crew, etc. The fishermen would be allocated a discrete amount of catch they may harvest in the year, which they can harvest at any time during the fishing year. Increases in stability would be expected as the fishermen can plan their use of IVQ, and they will know exactly how much red crab they can land each year. Both of these factors will reduce the uncertainty normally felt by fishermen unsure of when the fishery may close due to harvest levels.

There would be no reason to anticipate any derby-type fishing occurring, as there is no incentive to “race to fish.” Occupational opportunities would not be expected to change as a result of this measure, and may, in fact be improved from those associated with the simple hard TAC measure. Any reduction in occupational opportunities would result from an overall reduction in target yield from current landings levels or from the decisions made by individual fishermen (for instance, to take all of their available quota in a very short time in the beginning of the fishing year).

The proposed measure is not expected to have any effects on community infrastructure or the safety of fishery participants. There appears to be general support for this type of measure among the participants in the directed fishery, although most are somewhat hesitant until they know the amount of quota they are likely to be allocated.

5.3.11.6 Impacts of the Measure on Protected Species

Individual vessel quotas would not by themselves reduce red crab trap effort. Setting the overall TAC at 1999 levels would provide beneficial effects to protected species no matter how the TAC is managed, i.e., by DAS or IVQ.

5.4 Comparison of the Impacts of the Management Alternatives

5.4.1 Introduction

This section will compare and contrast the potential impacts of the ten proposed management alternatives under consideration in the Red Crab FMP. Please see Section 4.3 for an identification and description of the alternatives and the specific management

measures included in each. Table 22 indicates the measures contained within each management alternative under consideration. Each alternative, including the preferred alternative, presented in this section will be compared against two baselines: (1) the Emergency Rule alternative and (2) the no action alternative. The baseline for comparison is the regulatory environment which would exist if the Red Crab FMP is not implemented. The reason for two baselines in this case is that it is conceivable for one of two things to occur should this proposed FMP not be implemented.

Under one scenario, the red crab fishery would remain unregulated (as it was prior to the implementation of the emergency regulations) and there would be no further action to manage this fishery and protect the resource. This is equivalent to the “no action” alternative. Under the second scenario, rather than allow the fishery to remain unregulated with the inherent threat to the resource that that situation would present, NMFS, acting on behalf of the Secretary of Commerce, could implement interim management measures or some other safeguards, while they develop a Secretarial management plan for this fishery. Based on the measures developed and implemented by NMFS as emergency regulations, it seems reasonable to assume that the resulting management measures would appear very similar to the Emergency Rule.

5.4.1.1 Biological and Ecological Impacts of the Alternatives on Red Crab

While the alternatives differ from each other in their combinations of management measures, each one has at least some potential to create a derby-type fishery, which is undesirable. This could happen if the harvestable part of the resource is concentrated in a narrow depth zone and the large males are, or are perceived by fishermen to be, limited in number and have slow growth rates. Effort control measures like trip limits, days-at-sea, trap limits, gear restrictions, a controlled access system and individual vessel quotas will tend to spread out the catch over time and make the fishery less like a derby-type fishery. Because it would be concentrated into a short period of time, a derby-type fishery would increase the risk of causing a major disturbance to the mating process and to recruitment. Female red crabs with eggs have been seen throughout much of the year, but there is considerable uncertainty about when mating takes place.

Handling mortality is defined here as death from all factors related to red crabs being brought to the surface, handled, and returned to the bottom (because they cannot be sold). Handling mortality is distinct from fishing mortality (i.e., deaths of crabs that are landed and sold). There are no precise estimates of the magnitude of handling mortality for red crab. Furthermore, handling mortality is not addressed directly by any of the measures or alternatives being considered. If handling mortality is low, then these Alternatives have the potential to conserve the resource. However, if handling mortality is high, then many females and the smaller males die even when they are not landed (i.e., brought to the port). If handling mortality is high, then additional measures that reduce handling mortality could be warranted. It should be noted that it will not be possible to estimate the magnitude of handling mortality from the data that will be obtained under standard reporting requirements.

5.4.1.2 Ecological Impacts of the Alternatives on Other Species and Communities

Very little is known about the interactions of the deep-sea red crab with other species and their associated communities. The directed red crab fishery has no known interactions with other species or their associated communities, as the bycatch of other species in the red crab fishery is minimal. The impacts of this fishery on other species or their communities are expected to be minimal to non-existent. None of the management alternatives under consideration would be expected to change this conclusion and none of the management alternatives would result in more or less expected impact to other species or their communities.

5.4.1.3 Impacts of the Alternatives to Essential Fish Habitat

The only management measures under consideration with any potential relevance to impacts to the EFH of any managed species that may be associated with the directed red crab fishery are the proposed trap limits and the proposed gear restrictions. Both of these measures are proposed in Alternatives 2 through 7 as well as in Alternative 1, the emergency action baseline. Thus, there are no expected differences between these management alternatives and the first baseline. The no action alternative, Alternative 10, by definition would not include any type of trap limit or gear restrictions. Alternatives 2 through 7 all are less likely to result in any impacts to EFH than is the no action alternative, thus these alternatives are expected to have a more positive effect on the EFH of managed species than would the second baseline.

5.4.1.4 Economic Impacts of the Alternatives on the Fishery

In the strictest terms, alternatives are defined as a definitive set of measures. In this case, all of the alternatives to be considered compose a suite of possible measures, which are themselves open to debate, so that many different outcomes are possible under any one alternative. The preferred alternative has been defined as a suite of preferred options under many different measures. Descriptions of the impacts of each type of measure and the relevant options are provided in the previous section. The preferred option for each measure was identified and discussed.

In general, several different concepts of fishery management are being combined in the various alternatives. Many of these regulations have advantages and disadvantages, and some are only useful when used in combination with others. There are various tradeoffs between the regulations that determine what class of vessel may experience the greatest impacts. The “no action” alternative (Alternative 10) is considered to include no management action (i.e., the equivalent of having no FMP for this fishery). The “status quo” alternative (Alternative 1) is considered to include the management measures implemented through the emergency regulations. When comparisons are made, these are the two baselines to be compared with all other alternatives. Since the preferred alternative has been chosen, special emphasis will be given to the comparison of this versus all other alternatives. The assessment of the alternatives is done from the perspective of the nation rather than from that of private firms or individual vessels.

The economic impacts analyzed refer to the impacts of the alternatives on landings, revenues, ex-vessel prices, employment, and distributive effects. We can attempt to determine the direction of change in net benefits from the baseline levels, but it is difficult to determine the comparable net benefits of all alternatives. Because of the wide range of possibilities within each alternative, even the ranking of alternatives compared to the baselines is difficult. An attempt was made to outline the economic principles that should be considered when making comparisons of the alternatives to the two different baselines (Table 23 and Table 24). The degree of uncertainty in the direction of change from the baselines becomes clear. This table can also allow for some type of comparison between all of the alternatives, as cells which are different can point out positive or negative impacts. Landing projections over time for each alternative is what is needed before we can determine economic impacts to the nation.

Table 21 provides a comparison of the expected economic impact of all alternatives compared to the preferred alternative. Since there are very few positive impacts (+ characters) in Table 21, this implies that the preferred alternative compares favorably with all others. Notice the no action alternative generates almost all negative impacts (-) when compared to the preferred alternative.

The comparisons made between the baselines and the alternatives will be made using a long term time horizon, a sufficient period of time to allow a consideration of all expected effects. There will be short term benefits from some of the alternatives, but they may not be sustainable. In restrictive management alternatives, costs are incurred in the short-term and benefits are realized later.

There are some comments which would apply to all alternatives. All management alternatives (except “no action”) will include some level of incidental catch limits, based on the goal of FMP to “allow all fishermen the continued opportunity to land appropriate amounts of red crab as bycatch.” While they may have economic impacts for those vessels from the non-directed fishery, the impacts would be felt equally across all alternatives. All management alternatives (except “no action”) must include some degree of gear requirements and/or restrictions to, at a minimum, deal with marine mammal requirements, gear markings, and to ensure that the directed fishery is regulated as trap only. Any economic impacts from this measure would be felt equally among all alternatives. With the exception of the two baselines, all management alternatives include a provision for a controlled access system, consistent with an objective of the FMP, which states “develop a controlled access system to keep fishing capacity matched to the available resource.” Although there are economic impacts from the selection of the preferred option for controlled access, this measure would not be the cause of differing distributive impacts between the alternatives.

	Management Alternatives									
	Emergency Rule	Hard TAC and Trap Limits	Hard TAC, Trap and Trip Limits	Target TAC with DAS	Target TAC with DAS & Trip Limits	Trip Limits with # of Trips	All Possible Measures	IVQ with Controlled Access	IVQ Only	No Action
Economic elements¹⁶	1	2	3	4	5	6	7	8	9	10
Harvest level	0	0	0	0	Preferred Alternative	0	0	0	0	-
Employment	-	-	-	0		-	-	0	0	-
Price	-	-	-	0		-	-	0	0	-
Revenue ¹⁷	0	0	0	0		0	0	0	0	-
Vessel efficiency	-	-	-	0		-	-	0	0	-
Fishing season length	-	-	-	0		0	-	0	0	0
Industry output level										-
Harvesting/processing costs										-
Fleet size	-	0	0	0		0	0	0	0	-
Fleet composition										
Management costs, difficulty	0	0	0	+		+	-	+	+	++

Table 21: Expected economic impacts of all alternatives compared to the preferred alternative (#5).

All management alternatives (except “no action”) will include some level of reporting requirement to ensure that information is collected that is necessary for the continued management of the resource. There would be additional costs due to enforcement (which may include observers) and reporting but these appear to be non-controversial and would impact all alternatives equally.

While the alternatives differ in their combinations of management measures, many have the potential to promote a derby-type fishery. Effort control measures like trip

¹⁶ Economic impacts include market effects, profit effects, and fleet effect; They are rated positive (+), negative (-), neutral (0). Empty cells represent unknown effects or direction of change from baseline.

¹⁷ Assumes prices are held constant.

limits, days-at-sea, trap limits, and individual vessel quotas will tend to spread out the catch over time and make the fishery less like a derby-type fishery. These effort control measures differ in the efficiency and flexibility within which vessels can operate. An issue with economic significance is the disproportionate effects, by vessel size, for every alternative. A second significant issue is the share of the catch to be allocated among vessels with a history in the fishery and recent or new entrants. This is related to the interpretation of the control date of March 1, 2000, in qualifying recent or new entrants.

Red Crab Vessels

There are four characteristics of red crab vessels that are relevant to making a comparison between efficiency of the different vessels and how they would each be impacted under each of the alternatives: (1) fishing capacity; (2) hold capacity; (3) finished product and recovery rates; and (4) harvesting capacity. Fishing capacity refers to the number of pots that red crab vessels carry or use. The maximum hold capacity of a vessel indicates how much product (live or processed) the vessel can carry. The recovery rate depends on the degree of processing, if any, that occurs on board. Harvesting capacity refers to the amount of red crab that any one vessel could take on one trip. These issues are controversial and influence the impact of new vessels entering the fishery, as well as the impact of these alternatives on vessels in the fishery. Vessels impacted under any of the alternatives may have to do other things to remain profitable, either fish for red crabs on a part-time basis or fish in other regions outside the Northeast.

Red Crab Price

The ex-vessel price of red crab, according to the dealer weighout database, which is the only source of revenue information available, ranged, in 2000, from \$.55 to \$.94 per pound for individual vessels. This range in ex-vessel price among vessels is partly due to the different methods of processing and marketing, whether landed whole or with some degree of processing. The ex-vessel price of red crab by month ranged from \$.63 to \$.81. Average prices for each month were \$.69, \$.64, \$.71, \$.63, \$.63, \$.66, \$.67, \$.73, \$.74, \$.80, \$.81, \$.76 from January to December 2000, respectively. The ex-vessel price by port (\$.55 to \$.92) was very similar to the price received by vessels, reinforcing the fact that vessels land predominately in only one port.

Red Crab Revenue and Costs

The gross revenue per day required to break even ranges from \$4,000 to \$5,000. Based on the prices listed above, this would require minimum landings ranging from 2,200 pounds to 4,700 pounds per day. An average trip lasting 8 days means vessels would have to land between 17,600 pounds and 37,600 pounds to break even. The preferred alternative which includes a trip limit of 75,000 pounds would enable red crab vessels to break even, that is, cover their variable costs. The average variable cost/trip is approximately \$15,000. Vessels must cover their variable costs in the short run in order to continue fishing.

In the long term, vessels must cover their fixed costs to remain profitable. It

appears from the available information that red crab vessels would be able to allocate some of their trip revenue to cover their fixed costs. See Appendix B for a complete discussion of the revenues and costs of red crab vessels. There were no data on red crab imports or exports available from the U.S. Bureau of the Census. When compared to the no action alternative, all of these alternatives have a positive economic effect on the level of harvest. Since taking no action would drive the stock level down, any action at all would be an improvement over what harvest levels would become without management.

5.4.1.5 Social/Cultural Impacts of the Alternatives

The relative social and cultural impacts to fishermen and their communities of each management alternative under consideration are compared against those of two baselines: Alternative 1, the emergency action alternative, and Alternative 10, the no action alternative. The social and cultural impacts associated with the management measures proposed in the alternatives under consideration in many cases are dependent upon the specific options selected. In some cases, a single option may have positive social benefits for some members of the red crab fishery and negative social impacts for other members. For the purposes of this comparison of the potential impacts of the management alternatives under consideration, it is assumed that the same options would be selected under each alternative.

5.4.1.6 Impacts of the Alternatives on Protected Species

The protected species discussion in this section expands on the positive, negative, or, in some cases, lack of impacts of the management alternatives on protected resources, and provides comments on these packages relative to the two baselines described earlier. There is a focus on sperm whales as the protected species most likely to be affected by the operations of the red crab fishery, followed by a conclusion that no species inhabiting the waters of the management unit are expected to be adversely affected by any of the ten alternatives. All of the proposed alternatives, however, provide more positive benefits than the no action alternative.

	Management Alternatives									
	Emergency Rule	Hard TAC and Trap Limits	Hard TAC, Trap and Trip Limits	Target TAC with DAS	Target TAC with DAS & Trip Limits	Trip Limits with # of Trips	All Possible Measures	IVQ with Controlled Access	IVQ Only	No Action
Measures	1	2	3	4	5	6	7	8	9	10
Incidental catch limits	X	X	X	X	X	X	X	X	X	No Action Alternative
Minimum size							X			
Males only		X	X	X	X	X	X			
Butchering/processing restrictions		X	X	X	X	X	X			
Trap limits	X	X	X	X	X	X	X			
Gear requirements/restrictions	X	X	X	X	X	X	X	X	X	
Total allowable catch	X	X	X	X	X		X			
Trip limits	X		X		X	X	X			
Controlled access system		X	X	X	X	X	X	X		
Days-at-sea limits				X	X		X			
Individual vessel quotas								X	X	

Table 22: Identification of measures contained within each management alternative under consideration in the Red Crab FMP.

5.4.2 Alternative 1: “Emergency Rule”

This non-preferred alternative proposed to implement the set of management measures that most closely resembles those implemented by NMFS in the Emergency Regulations. Alternative 1 differs from Alternative 10 (the “no action” baseline) by including measures for incidental catch limits, trap limits, some gear requirements, a hard TAC, and trip limits.

5.4.2.1 Biological and Ecological Impacts of the Alternative on Red Crab

Compared to Alternative #10, in what ways might this Alternative have a more positive effect on red crabs?

Incidental catch limits will prevent excessive red crab landings by vessels from other fisheries. Trap limits can limit catch rates and gear restrictions can allow small red crabs to escape from traps. A hard TAC with reporting requirements for each trip will reduce the probability of overfishing.

Compared to Alternative #10, in what ways might this Alternative have a more negative effect on red crabs?

There are no conditions under which this alternative would be expected to have more negative effects on red crabs than Alternative 10.

5.4.2.2 Ecological Impacts of the Alternative on Other Species and Communities

There are no expected differences in the ecological impacts on other species or their communities between this management alternative and Alternative 10.

5.4.2.3 Impacts of the Alternative to Essential Fish Habitat

The no action alternative, Alternative 10, by definition would not include any type of trap limit or gear restrictions. This alternative is less likely to result in any impacts to EFH than is the no action alternative, thus this alternative is expected to have a more positive effect on the EFH of managed species than would the second baseline.

5.4.2.4 Economic Impacts of the Alternative on the Fishery

Alternative 1 would implement a set of measures most similar to those implemented under the emergency regulations. The emergency regulations implemented a hard TAC (based on an estimate of MSY), a trip limit, and a trap limit. This alternative does not include a controlled access system.

Alternative 1 would not preclude the continuation of all vessels in the red crab fishery. Although this alternative does not restrict any degree of processing at sea, it may do so indirectly by imposing a trip limit. So, even though processing would be allowed, it is not clear whether vessels would choose to process on board under this alternative.

The trip limit, in combination with the hard TAC, could still promote a derby fishery but would allow for a more equitable distribution of landings in time and space than would a TAC used alone. However, the vessels capable of landings far greater than the trip limit may be forced to operate in an inefficient manner or not participate in the fishery at all. It is quite possible that they may not cover their variable costs on these limited trips. This one measure, if set low, may force some vessels out of the fishery or preclude them from entering the fishery. Larger vessels presumably have greater expenses and the trip limit may not allow them to earn enough revenue to justify making such a trip.

It is impossible to estimate how many vessels, if any, might be eliminated by this alternative. While some impacted vessels might continue to make trips and land only up to the trip limit, some vessels might cease making trips, because the trip limit would not

provide for profitable trips. It is possible that the effort from the eliminated trips could move into other areas where vessels could make up for lost revenue. However, it is not clear at what level this would occur, or how much additional revenue this would create for vessels. Revenue would essentially be capped under this alternative. It is difficult to determine what effect this alternative would have on the variable costs of the vessels involved.

From what we understand about the vessel length and gross registered tonnage of vessels in this fishery, we can say that there are likely to be some disproportionate effects by vessel size class. The larger vessels would be more likely to be impacted than the smaller vessels, through a reduction in total gross revenues. Most of the smaller vessels would presumably be able to continue fishing in the manner that was closer to their past behavior.

The trip limits could have a differential impact on vessels with different levels of productivity (which would be indicated by their landings-per-unit-efforts (LPUE) if these were known). Higher productivity vessels will be constrained more by the trip limits compared to the vessels that have a lower LPUE. On the other hand, the actual trip length would likely be shorter for the high productivity vessels; thus their trip costs may be less (everything else being equal) compared to smaller vessels that have to fish longer to land the trip limit. The trip limit would require the more productive vessels to take more trips than their ability requires. Their trip costs are lower than their counterparts, but higher than necessary to harvest their effective allocation.

Trip limits and pot limits may be somewhat redundant. The use of pot limits is questionable, given that the vessels haul pots multiple times on a trip and that a pot limit is difficult to enforce at sea. Some vessels may be able to use the combination of a pot limit and a trip limit to their advantage. For example, some may be able to increase the number of pots per trawl, catch their trip limit quicker, resulting in a shorter trip, with the possibility of making a greater number of trips. The implementation of pot limits may prove to be somewhat problematic, as well.

A few positive economic effects can be felt from Alternative 1, if compared with no action at all. Incidental catch is regulated under Alternative 1, preventing those vessels from directing on red crab. Restrictions on number of entrants will prevent additional vessels from entering the fishery and leaving it overcapitalized. Historic participants are less likely to be eliminated from the fishery or become marginally viable. Required reporting would improve the data availability for this fishery.

5.4.2.5 Social/Cultural Impacts of the Alternative

There are no specific measures within this alternative that would be expected to provide social and/or cultural benefits to the red crab fishery compared with Alternative 10, but, overall, implementing a management program for the red crab fishery that reduces the probability of overfishing and reduces the likelihood of the fishery becoming overcapitalized will have an overall positive effect on the social and cultural aspects of the fishery.

5.4.2.6 Impacts of the Alternative on Protected Species

The emergency regulations implemented a 180-day hard TAC of 2.5 million pounds, a 65,000 pound trip limit, a 600-trap limit, a 100 pound incidental catch limits for vessels not participating in the direct red crab fishery, and reporting requirements for all participants. The TAC level equals the estimated MSY for the fishery, but is higher than the historical annual landings, although it is reported that the 2000 landings exceeded the MSY level. The trip limit is the average size for the historic fleet, and the trap limit is less than 100 traps higher than the historic fleet level. The incidental catch limit may reduce participation from other fisheries. The gear requirements proposed would not provide any additional protection beyond what is already provided under the MMPA regulations that implement the ALWTRP. The reporting requirement will provide additional information regarding the seasonal and area distribution of red crab fishing effort to allow managers to better assess the actual overlap of the fishery with protected species. However, implementation of an effort-capping scheme will provide more protection than the No Action alternative.

The effort control/reduction measures (TAC, trip and trap limits, and incidental catch limits) all serve to control the growth of the fishery that would result in more fixed gear being set in high use waters for protected species, namely the endangered sperm whale and other odontocetes protected under the MMPA; as well as migratory or occasional foraging habitat for the endangered right, humpback, fin, blue and sei whales and the endangered leatherback sea turtle. However, Alternative 1 would not provide any additional protection to the endangered large whales and leatherback sea turtle during their high use period along the continental shelf edge (Spring months of April - June).

5.4.3 Alternative 2: Hard TAC with Trap Limits

This non-preferred alternative proposed to implement a set of management measures to control total fishing effort and landings primarily through the use of a hard TAC. Alternative 2 differs from Alternative 1 by including options for a male-only fishery, butchering and processing restrictions, and a controlled access system, but does not include the option for a trip limit. Alternative 10, the no action alternative, includes no management measures, so all the measures proposed in Alternative 2 differ from Alternative 10.

5.4.3.1 Biological and Ecological Impacts of the Alternative on Red Crab

Compared to Alternative #1, in what ways might this Alternative have a more positive effect on red crabs?

By limiting the landings to males, females will be protected from direct fishing mortality. Females still might incur high handling mortality. We do not know how high handling mortality is, so traps should be designed to reduce the capture of crabs that must be returned or that are too small to have much meat yield. Protecting the females will promote population growth, but this will occur only if sufficient numbers of large males are left in the population.

The amount of processing allowed will affect whether this alternative can be put into practice successfully. The most extreme hypothetical case would be if at-sea processing was eliminated, and only whole, male crabs could be landed. Resulting positive effects would include the ability to monitor compliance with the male-only measure and protection of females and small males. In addition, this might limit the number of crabs taken per trip because the ships' storage areas would fill more quickly per capita of crab landed. In contrast, if processing at sea were allowed with only minor restrictions, then it would not be possible to monitor what was being landed or to protect females or smaller males.

Controlled access will limit the number of vessels harvesting red crab and make it easier to monitor and enforce a hard TAC. Reporting requirements will also support monitoring and enforcement.

Compared to Alternative #1, in what ways might this Alternative have a more negative effect on red crabs?

The TAC will limit the overall catch, but without trip limits (or some other measure which causes trips to end) this could become a derby-type fishery whereby most of the annual catch is taken in a short period of time. If all of the catch was removed during a critical time for red crab reproduction, this could reduce future recruitment. Female red crabs with eggs have been seen throughout much of the year, but there is considerable uncertainty about when mating takes place. Avoiding a derby fishery would lower the risk of causing a major disturbance to the mating process.

Without trip limits, recovery ratios cannot be used to constrain each trip to have roughly the same maximum number of crabs (i.e., no upper limit on mortality per trip).

Compared to Alternative #10, in what ways might this Alternative have a more positive effect on red crabs?

By limiting the landings to males, females will be protected from direct fishing mortality. Females still might incur high handling mortality. We do not know how high handling mortality is, so traps should be designed to reduce the capture of crabs that must be returned or that are too small to have much meat yield. Protecting the females will promote population growth, but this will occur only if sufficient numbers of large males are left in the population.

The amount of processing allowed will affect whether this alternative can be put into practice successfully. The most extreme hypothetical case would be if at-sea processing was eliminated, and only whole, male crabs could be landed. Resulting positive effects would include ability to monitor compliance with the male-only measure and protection of females and small males. In addition, this might limit the number of crabs taken per trip because the ships' storage areas would fill more quickly per capita of crab landed. In contrast, if processing at sea were allowed with only minor restrictions, then it would not be possible to monitor what was being landed or to protect females or smaller males.

Controlled access will limit the number of vessels harvesting red crab and make it easier to monitor and enforce the hard TAC. Reporting requirements will also support this. Incidental catch limits will prevent excessive red crab landings by vessels from other fisheries. Trap limits can limit catch rates and gear restrictions can allow small red crabs to escape from traps. A hard TAC with reporting requirements for each trip will reduce the probability of overfishing.

Compared to Alternative #10, in what ways might this Alternative have a more negative effect on red crabs?

There are no conditions under which this alternative would be expected to have more negative effects on red crabs than Alternative 10.

5.4.3.2 Ecological Impacts of the Alternative on Other Species and Communities

There are no expected differences in the ecological impacts on other species or their communities between this management alternative and the first baseline, Alternative 1, the emergency action alternative. The only difference in the ecological impacts on other species or their communities expected between this management alternative and the second baseline, Alternative 10, the no action alternative, is that associated with the prohibition on all fishing gear types other than traps in the directed red crab fishery, which would be expected to confer benefits to other species and their communities by preventing the use of mobile gear such as otter trawls and dredges.

5.4.3.3 Impacts of the Alternative to Essential Fish Habitat

The relative impacts to essential fish habitat (EFH) of each management alternative under consideration are compared against those of two baselines: Alternative 1, the emergency action alternative, and Alternative 10, the no action alternative.

The only management measures under consideration with any potential relevance to impacts to the EFH of any managed species that may be associated with the directed red crab fishery are the proposed trap limits and the proposed gear restrictions. Both of these measures are proposed in this alternative as well as in Alternative 1, the emergency action baseline. Thus, there are no expected differences between this management alternative and the first baseline. The no action alternative, Alternative 10, by definition would not include any type of trap limit or gear restrictions. This alternative is less likely to result in any impacts to EFH than is the no action alternative, thus this alternative is expected to have a more positive effect on the EFH of managed species than would the second baseline.

5.4.3.4 Economic Impacts of the Alternative on the Fishery

Alternative 2 would control total fishing effort and landings primarily through the use of a hard TAC. The primary mechanism to make fishing effort equivalent among vessels and to prevent expansion of effort would be a trap limit. A controlled access system would be implemented to limit the number of vessels participating in the directed fishery to an appropriate number.

Trap limits work by reducing the efficiency of the fishing activity, by forcing fishermen to use a smaller number of traps that they may be accustomed to. A lesser number of traps would reduce the catch, without any associated reduction of costs, resulting in reduced profitability. Since this alternative relies exclusively on trap limits to help spread the landings out over the year, to do so effectively the limit would have to be set so low that it would affect all vessels revenue.

Controlled access will limit the participation of vessels harvesting red crab. From society's point of view, this means there is a reduction in the accumulation of excess capital and lower costs. Alternative 2 would force participating vessels to be very inefficient (affecting some vessels more than others) because the primary mechanism to control effort is through a trap limit. Cost per crab harvested would be higher; to utilize their full vessel capacity, they may try to extend the length of their trip.

Vessels are operating inefficiently, not due to a trip limit (as in Alternative 1), but due to restrictive trap limits instead. Trap limits in conjunction with TAC prevent a complete derby, but almost certainly would have the fishery shut down prior to the end of the fishing year. Employment in the processing sector would have to adjust to fluctuating supply; even though processors are only 11.5% dependent on red crab on average, they would still have to adjust to unsteady levels, assuming the fishery would be shut down early.

The degree of processing allowed will affect whether vessels would have to change their current fishing behavior. If they were forced to modify their method of harvesting, it would add to their costs, and some vessels may no longer be profitable. Some may be forced out of the fishery. Not allowing processing at sea would certainly be dissuasive to the freezer/processor vessel owners, given the presumably higher fixed and variable costs associated with operation of larger vessels, processing facilities and the employment of additional crew. In contrast, if processing at sea were allowed with only minor restrictions, vessels would have the flexibility to continue their fishing, not affecting their costs. Other measures would have to be restrictive. Instability of supply would cause fluctuations in availability and price.

Compared to no action, the only positive aspect of Alternative 2 is that data would be gathered which would enable future management actions to use more comprehensive, reliable, and timely information on the fishery.

5.4.3.5 Social/Cultural Impacts of the Alternative

Compared to Alternative 1, in what ways might this alternative have a more positive social/cultural impact?

Butchering/processing restrictions are expected to have positive social impacts on the fishermen involved in the directed red crab fishery unless the most restrictive option, a total prohibition on all butchering and processing at sea, is selected. A controlled access system will provide positive social impacts on the vessels authorized to participate in the directed red crab fishery.

Compared to Alternative 1, in what ways might this alternative have a more negative social/cultural impact?

If the most restrictive option for butchering/processing restrictions is selected, this alternative has the potential to cause negative social impacts on some members of the directed red crab fishery. The controlled access system may have negative social impacts on the vessels excluded from participating in the directed red crab fishery. Depending upon the option selected and the level of the trip limit set for the directed red crab fishery, trip limits may be expected to have a positive social impact on members of the red crab fishery by mitigating some of the potential negative social impacts associated with a hard TAC. These potential negative social impacts will not be mitigated in Alternative 2, so it may have a more negative social impact than Alternative 1.

Compared to Alternative 10, in what ways might this alternative have a more positive social/cultural impact?

Butchering/processing restrictions are expected to have positive social impacts on the fishermen involved in the directed red crab fishery unless the most restrictive option, a total prohibition on all butchering and processing at sea, is selected. The gear requirements options offer potential social benefits, resulting from the proposed prohibition on all fishing gear other than traps. A controlled access system will provide positive social impacts on the vessels authorized to participate in the directed red crab fishery. Overall, implementing a management program for the red crab fishery that reduces the probability of overfishing and reduces the likelihood of the fishery becoming overcapitalized will have an overall positive effect on the social and cultural aspects of the fishery.

Compared to Alternative 10, in what ways might this alternative have a more negative social/cultural impact?

If the most restrictive option for butchering/processing restrictions is selected, this alternative has the potential to cause negative social impacts on some members of the directed red crab fishery. The controlled access system may have negative social impacts on the vessels excluded from participating in the directed red crab fishery.

5.4.3.6 Impacts of the Alternative on Protected Species

A hard TAC set at MSY would represent a somewhat higher catch than historic levels, but would serve to set an appropriate limit for future growth. Trap limits are also beneficial for protected species as it caps the amount of gear that can be set for each vessel. Trap limits below the current average level of 560 may not reduce the number of strings used, although trap limits above the current level may increase the number of strings and accompanying vertical buoy lines. We note that TAC alone does not control the timing of the effort. Derby fishing for a hard TAC may bring the bulk of the effort into direct conflict with the spring high use of the continental shelf edge by endangered large whales and the leatherback sea turtle. Incidental catch limits will serve to limit growth of non-directed red crab fisheries such as offshore lobster along the continental

shelf edge provided the level chosen is at/or below the current landings. The reporting requirement will provide additional information regarding the seasonal and area distribution of red crab fishing effort to allow managers to better assess the actual overlap of the fishery with protected species. The gear requirements proposed would not provide any additional protection beyond what is already provided under the MMPA regulations that implement the ALWTRP. The requirement for males only and the butchering/processing at-sea will not provide any protection for protected species.

Using only TAC to control the fishery is an adequate effort control on the growth of the fishery, thus curbing uncontrolled growth that would result in more fixed gear being set in high use waters for protected species, namely the endangered sperm whale and other odontocetes protected under the MMPA; as well as migratory or occasional foraging habitat for the endangered right, humpback, fin, blue and sei whales and the endangered leatherback sea turtle. Since the level of TAC, trap limits, and incidental catch limits are not yet chosen, we cannot assess the protected species effects with respect to Alternative 1. However, implementation of an effort-capping scheme will provide more protection than Alternative 10.

5.4.4 Alternative 3: Hard TAC, Trap Limits and Trip Limits

This non-preferred alternative proposed to implement a set of management measures to control total fishing effort and landings primarily through the use of a hard TAC, but would also implement trip limits as a tool to reduce the likelihood of creating a derby fishery. Alternative 3 differs from Alternative 1 by including options for a male-only fishery, butchering/processing restrictions, and a controlled access system. Alternative 10, the no action alternative, includes no management measures, so all the measures proposed in Alternative 3 differ from Alternative 10.

5.4.4.1 Biological and Ecological Impacts of the Alternative on Red Crab

Compared to Alternative #1, in what ways might this Alternative have a more positive effect on red crabs?

This alternative has all the advantages of Alternative 2, plus the trip limit can work along with the butchering/processing restriction and the male-only requirement to limit the size range, sex and number of red crabs that are landed per trip. This combination of measures may serve to spread the catch out to some degree across seasons (reduce, but not eliminate the potential for a derby-type fishery), limit the catch to large males (which should allow females to continue reproducing), and allow the catch to be monitored for stock assessment.

Compared to Alternative #1, in what ways might this Alternative have a more negative effect on red crabs?

There are no conditions under which this alternative would have a more negative effect on red crabs than Alternative 1.

Compared to Alternative #10, in what ways might this Alternative have a more

positive effect on red crabs?

This has all the advantages of Alternative 2, plus the trip limit can work along with the butchering/processing restriction and the male-only requirement to limit the size range, sex and number of red crabs that are landed per trip. This combination of measures will spread the catch out across seasons (reduce the derby-type fishery), limit the catch to large males (which should allow females to continue reproducing), and allow the catch to be monitored for stock assessment.

Compared to Alternative #10, in what ways might this Alternative have a more negative effect on red crabs?

There are no conditions under which this alternative would be expected to have more negative effects on red crabs than Alternative 10.

5.4.4.2 Ecological Impacts of the Alternative on Other Species and Communities

There are no expected differences in the ecological impacts on other species or their communities between this management alternative and the first baseline, Alternative 1, the emergency action alternative. The only difference in the ecological impacts on other species or their communities expected between this management alternative and the second baseline, Alternative 10, the no action alternative, is that associated with the prohibition on all fishing gear types other than traps in the directed red crab fishery, which would be expected to confer benefits to other species and their communities by preventing the use of mobile gear such as otter trawls and dredges.

5.4.4.3 Impacts of the Alternative to Essential Fish Habitat

The relative impacts to essential fish habitat (EFH) of each management alternative under consideration are compared against those of two baselines: Alternative 1, the emergency action alternative, and Alternative 10, the no action alternative.

The only management measures under consideration with any potential relevance to impacts to the EFH of any managed species that may be associated with the directed red crab fishery are the proposed trap limits and the proposed gear restrictions. Both of these measures are proposed in this alternative as well as in Alternative 1, the emergency action baseline. Thus, there are no expected differences between this management alternative and the first baseline. The no action alternative, Alternative 10, by definition would not include any type of trap limit or gear restrictions. This alternative is less likely to result in any impacts to EFH than is the no action alternative, thus this alternative is expected to have a more positive effect on the EFH of managed species than would the second baseline.

5.4.4.4 Economic Impacts of the Alternative on the Fishery

In an effort to spread out the landings of red crab and reduce the potential for creating a derby-style fishery, Alternative 3 includes all the measures from the previous alternative with the addition of trip limits. This alternative is also very similar to the

"Emergency Rule" alternative with the addition of the male-only restriction and some form of butchering or processing at sea restriction.

The trip limit, in combination with the hard TAC, would help prevent (although certainly not eliminate) a derby fishery and allow for a more equitable distribution of landings in time and space. However, the vessels capable of landings far greater than the trip limit may be forced to operate in an inefficient manner or not participate in the fishery at all. It is quite possible that they may not cover their variable costs on these limited trips. This one measure may possibly force some vessels out of the fishery or preclude them from entering the fishery. Larger vessels presumably have greater expenses and the trip limit may not allow them to earn enough revenue to justify making such a trip.

It is impossible to estimate how many vessels, if any, might be eliminated by this alternative. While some impacted vessels might continue to make trips and land only up to the trip limit, some vessels might cease making trips, because the trip limit would not provide for profitable trips. It is possible that the effort from the eliminated trips could move into other areas where vessels could make up for lost revenue. However, it is not clear at what level this would occur, or how much additional revenue this would create for vessels. The trip limit would require the more productive vessels to take more trips than their ability requires. Their trip costs are lower than their counterparts, but higher than necessary to harvest their effective allocation.

Compared to the two baselines, Alternative 3 would limit the number of vessels harvesting red crab through controlled access. From society's point of view, this means there is a reduction in the accumulation of excess capital and lower costs. Those other resources (who are not in the fishery) can be directed elsewhere. This combination of measures will spread the catch out across seasons (reduce the derby-type fishery).

Compared to the preferred alternative (Alternative 5), increased inefficiency of vessel operations due to both trap limits and trip limits would raise vessels costs without a corresponding increase in revenue. Both trap and trip limits strive to control effort by forcing vessels to operate at less than their full capacity. Additional controls would increase enforcement costs.

As with Alternative 1, the degree of processing allowed will affect whether vessels would have to change their current fishing behavior. If they were forced to modify their method of harvesting, it would add to their costs, and some vessels may no longer be profitable. Some may be forced out of the fishery. Not allowing processing at sea would certainly be dissuasive to the freezer/processor vessel owners, given the presumably higher fixed and variable costs associated with operation of larger vessels, processing facilities and the employment of additional crew. In contrast, if processing at sea were allowed with only minor restrictions, vessels would have the flexibility to continue their fishing, not affecting their costs. Other measures would have to be restrictive.

In all but the no action alternative, data would be gathered which would enable future management actions to use more comprehensive, reliable, and timely information

on the fishery. Historic participants may be able to remain in the fishery, even if they have to operate in a less efficient manner.

5.4.4.5 Social/Cultural Impacts of the Alternative

Compared to Alternative 1, in what ways might this alternative have a more positive social/cultural impact?

The positive effects of this alternative compared to Alternative 1 are the same as for Alternative 2.

Compared to Alternative 1, in what ways might this alternative have a more negative social/cultural impact?

The negative effects of this alternative compared to Alternative 1 are the same as for Alternative 2, with the exception of those impacts associated with trip limits.

Compared to Alternative 10, in what ways might this alternative have a more positive social/cultural impact?

The positive effects of this alternative compared to Alternative 10 are the same as for Alternative 2 with the addition of trip limits which may be expected to have a positive social impact on members of the red crab fishery by mitigating some of the potential negative social impacts associated with a hard TAC.

Compared to Alternative 10, in what ways might this alternative have a more negative social/cultural impact?

The negative effects of this alternative compared to Alternative 10 are the same as for Alternative 2.

5.4.4.6 Impacts of the Alternative on Protected Species

A hard TAC set at MSY would represent a somewhat higher catch than historic levels, but would serve to set an appropriate limit for future growth. Trap limits are also beneficial for protected species as it caps the amount of gear that can be set for each vessel. Trap limits below the current average level of 560 may not reduce the number of strings used, although trap limits above the current level may increase the number of strings and accompanying vertical buoy lines. Adding trip limits to a TAC does not change the protected species effects from Alternative 2, as vessels may still make quick turn-around trips, maintaining the possible adverse effects of a derby fishery occurring during the spring high use of the continental shelf edge by endangered large whales and the leatherback sea turtle. Incidental catch limits will serve to limit growth of non-directed red crab fisheries such as offshore lobster along the continental shelf edge provided the level chosen is at/or below the current landings. The reporting requirement will provide additional information regarding the seasonal and area distribution of red crab fishing effort to allow managers to better assess the actual overlap of the fishery with protected species. The gear requirements proposed would not provide any

additional protection beyond what is already provided under the MMPA regulations that implement the ALWTRP. The requirement for males only and the butchering/processing at-sea will not provide any protection for protected species.

An alternative with hard TAC, trap limits, and trip limits will provide adequate control on the growth of the fishery, thus curbing uncontrolled growth that would result in more fixed gear being set in high use waters for protected species, namely the endangered sperm whale and other odontocetes protected under the MMPA; as well as migratory or occasional foraging habitat for the endangered right, humpback, fin, blue and sei whales and the endangered leatherback sea turtle. Since the level of TAC, trap limits, and incidental catch limits are not yet chosen, we cannot assess the protected species effects with respect to Alternative 1. However, implementation of an effort-capping scheme will provide more protection than Alternative 10.

5.4.5 Alternative 4: Target TAC with Days-at-Sea

This non-preferred alternative proposed to implement a set of management measures to control effort in the fishery primarily through the allocation of DAS to all vessels authorized to participate in the directed red crab fishery. Alternative 4 differs from Alternative 1 by including options for a male-only fishery, butchering/processing restrictions, a controlled access system and days-at-sea limits, but does not include the option for trip limits and would use a target TAC rather than a hard TAC. Alternative 10, the no action alternative, includes no management measures, so all the measures proposed in Alternative 4 differ from Alternative 10. Alternative 4 differs from the preferred alternative only in that it does not include trip limits.

5.4.5.1 Biological and Ecological Impacts of the Alternative on Red Crab

Compared to Alternative #1, in what ways might this Alternative have a more positive effect on red crabs?

By limiting the landings to males, females will be protected from direct fishing mortality. Females still might incur high handling mortality. We do not know how high handling mortality is, so traps should be designed to reduce the capture of crabs that must be returned or that are too small to have much meat yield. Protecting the females will promote population growth, but this will occur only if sufficient numbers of large males are left in the population.

The amount of processing allowed will affect whether this alternative can be put into practice successfully. The most extreme hypothetical case would be if at-sea processing was eliminated, and only whole, male crabs could be landed. Resulting positive effects would include the ability to monitor compliance with the male-only measure and protection of females and small males. In addition, this might limit the number of crabs taken per trip because the ships' storage areas would fill more quickly per capita of crab landed. In contrast, if processing at sea were allowed with only minor restrictions, then it would not be possible to monitor what was being landed or to protect females or smaller males.

Controlled access will limit the number of vessels harvesting red crab and make it easier to monitor total landings. Reporting requirements will also support monitoring and enforcement.

A limit on days-at-sea per vessel serves as the primary method of controlling fishing effort and catch. This will tend to spread out the effort, because each vessel in the fishery will be assured of a certain amount of time to fish. Spreading out the catch over time is probably less of a disturbance to the red crab population, especially to the mating system.

Compared to Alternative #1, in what ways might this Alternative have a more negative effect on red crabs?

The “days-at-sea” measure is a way of managing fishing effort to try to achieve the target TAC. The calculation of days-at-sea per vessel must be completed before the fishing year, and the calculation requires assumptions about the number of vessels, their average catch per trip, and the average days per trip. A further complication is that the days-at-sea for each red crab vessel might have to be estimated taking into account different types of vessels with different amounts of crab processing. Because the calculation of days-at-sea is indirect, the realized catch after one year using all the days-at-sea might over- or under-shoot the target TAC. This is different from a hard TAC, where the fishery closes as soon as the hard TAC is taken. It should be expected that if both a target TAC and days-at-sea are implemented, the target TAC will have to be adjusted each year to account for the previous year’s difference between the realized and target catch. Choosing the right number of days-at-sea to achieve the target TAC is more difficult if there are changes over time in fishing gear, hold capacity, or other fishing regulations (e.g., trip limits).

As an alternative to a simple equal allocation of DAS among all participating vessels, or a category-based allocation, recovery ratios could be used to adjust days-at-sea for vessels planning different amounts of processing, but the formula for doing this would be more difficult to derive (and probably less accurate at correctly assigning days-at-sea) than applying recovery ratios to an alternative with trip limits.

Compared to Alternative #10, in what ways might this Alternative have a more positive effect on red crabs?

By limiting the landings to males, females will be protected from direct fishing mortality. Females still might incur high handling mortality. We do not know how high handling mortality is, so traps should be designed to reduce the capture of crabs that must be returned or that are too small to have much meat yield. Protecting the females will promote population growth, but this will occur only if sufficient numbers of large males are left in the population.

The amount of processing allowed will affect whether this alternative can be put into practice successfully. The most extreme hypothetical case would be if at-sea processing was eliminated, and only whole, male crabs could be landed. Resulting

positive effects would include ability to monitor compliance with the male-only measure and protection of females and small males. In addition, this might limit the number of crabs taken per trip because the ships' storage areas would fill more quickly per capita of crab landed. In contrast, if processing at sea were allowed with only minor restrictions, then it would not be possible to monitor what was being landed or to protect females or smaller males.

Controlled access will limit the number of vessels harvesting red crab and make it easier to monitor total landings. Reporting requirements will also support this.

A limit on days-at-sea per vessel serves as the primary method of controlling fishing effort and catch. This will tend to spread out the effort, because each vessel in the fishery will be assured of a certain amount of time to fish. Spreading out the catch over time is probably less of a disturbance to the red crab population, especially to the mating system.

Incidental catch limits will prevent excessive red crab landings by vessels from other fisheries. Trap limits can limit catch rates and gear restrictions can allow small red crabs to escape from traps. A target TAC with reporting requirements for each trip will reduce the probability of overfishing.

Compared to Alternative #10, in what ways might this Alternative have a more negative effect on red crabs?

There are no conditions under which this alternative would be expected to have more negative effects on red crabs than Alternative 10.

5.4.5.2 Ecological Impacts of the Alternative on Other Species and Communities

There are no expected differences in the ecological impacts on other species or their communities between this management alternative and the first baseline, Alternative 1, the emergency action alternative. The only difference in the ecological impacts on other species or their communities expected between this management alternative and the second baseline, Alternative 10, the no action alternative, is that associated with the prohibition on all fishing gear types other than traps in the directed red crab fishery, which would be expected to confer benefits to other species and their communities by preventing the use of mobile gear such as otter trawls and dredges.

5.4.5.3 Impacts of the Alternative to Essential Fish Habitat

The relative impacts to essential fish habitat (EFH) of each management alternative under consideration are compared against those of two baselines: Alternative 1, the emergency action alternative, and Alternative 10, the no action alternative.

The only management measures under consideration with any potential relevance to impacts to the EFH of any managed species that may be associated with the directed red crab fishery are the proposed trap limits and the proposed gear restrictions. Both of these measures are proposed in this alternative as well as in Alternative 1, the emergency

action baseline. Thus, there are no expected differences between this management alternative and the first baseline. The no action alternative, Alternative 10, by definition would not include any type of trap limit or gear restrictions. This alternative is less likely to result in any impacts to EFH than is the no action alternative, thus this alternative is expected to have a more positive effect on the EFH of managed species than would the second baseline.

5.4.5.4 Economic Impacts of the Alternative on the Fishery

Alternative 4 would implement many of the same measures as previous alternatives but the principle mechanism to control effort in the fishery would be the use of vessel days-at-sea (DAS). The objective of the alternative would be to allow the appropriate number of DAS to harvest, but not exceed, the target TAC. The effectiveness of this alternative is not directly dependent on the number of vessels participating, but on the calculation of the total number of days that would allow for the target catch to be landed. If the additional measures (especially trap limits) were not used as limiting factors, this alternative has potential to have one of the higher levels of net benefits, since it allows for the market to control production. As long as other measures are not introduced to effect the behavior of vessels, they will be able to maximize their outputs from a given level of inputs, assuming the biomass increases over time.

The potential OY for the fishery that would determine the TAC ranges from 1.254 to 7.904 million pounds. Using this range, we can calculate a range of possible DAS allocations, depending on MSY and fleet size. This range is 11 DAS per vessel if 17 vessels are fishing on a TAC of 1.254 million pounds, up to 296 DAS per vessel if only four vessels are fishing on a TAC of 7.904 million pounds. Given the uncertainty in the parameters, this range from 11 to 296 DAS illustrates the degree of flexibility that exists in the individual measures. We can assume that the actual DAS would be somewhere in the middle of the range.

The preferred alternative specifies an OY for the fishery of 5.928 million pounds. This would translate into 52 DAS per vessel if 17 vessels were fishing up to 222 DAS per vessel if only four vessels were fishing. If five vessels (or six) were fishing, the individual DAS allotted would be 178 (or 148). Given that the reported number of days absent among the red crab vessels varies from 200 to 300, we can assume that they would all have to cut back on their effort. Since DAS will be restrictive, they can make adjustments to their behavior to accommodate this change, by planning for other sources of income.

Controlled access will limit the participation of vessels harvesting red crab. From society's point of view, this means there is a reduction in the accumulation of excess capital and lower costs. Those other resources (who are not in the fishery) can be directed elsewhere. This alternative would allow greater continuity of effort and supplies to the market and avoids a negative response to short term fluctuations.

This alternative would prevent a derby fishery if the initial allocation of DAS is set correctly. The continuous annual adjustment in target TAC enables management of the

resource to respond to changes in stock condition without a costly and timely management process. A high degree of flexibility is afforded to participants in the fishery concerning when and how long to fish. Processors will be assured of a steady supply of fresh product.

Since the calculation of DAS works from a target TAC, it provides less tight control over the level of catch than a hard TAC. Choosing the right number of days-at-sea to achieve the target TAC is more difficult if there are changes over time in fishing gear, hold capacity, or other fishing regulations (e.g., trip limits). The success of this alternative would depend on allowing the DAS to be the principle restriction, and on the careful calculation, and adjustment of the effort restriction.

The degree of processing allowed will affect whether vessels would have to change their current fishing behavior. If they were forced to modify their method of harvesting, it would add to their costs, and some vessels may no longer be profitable. Some may be forced out of the fishery. Not allowing processing at sea would certainly be dissuasive to the freezer/processor vessel owners, given the presumably higher fixed and variable costs associated with operation of larger vessels, processing facilities and the employment of additional crew. In contrast, if processing at sea were allowed with only minor restrictions, vessels would have the flexibility to continue their fishing, not affecting their costs. Other measures would have to be restrictive.

This alternative would prevent a rush to catch all remaining large males. Alternative 4 allows a more predictable level of supplies to market (retailers and consumers) and to the processors. The continuous annual adjustment in target TAC enables management of the resource to respond to changes in stock condition without costly and timely management process. A high degree of flexibility is afforded to participants in the fishery concerning when and how long to fish.

5.4.5.5 Social/Cultural Impacts of the Alternative

Compared to Alternative 1, in what ways might this alternative have a more positive social/cultural impact?

Butchering/processing restrictions are expected to have positive social impacts on the fishermen involved in the directed red crab fishery unless the most restrictive option, a total prohibition on all butchering and processing at sea, is selected. A controlled access system will provide positive social impacts on the vessels authorized to participate in the directed red crab fishery. Days-at-sea (DAS) limits are expected to provide positive social benefits to the fishermen involved in the directed red crab fishery by preventing a derby fishery and allowing them more flexibility and stability, while reducing uncertainty.

Compared to Alternative 1, in what ways might this alternative have a more negative social/cultural impact?

If the most restrictive option for butchering/processing restrictions is selected, this alternative has the potential to cause negative social impacts on some members of the

directed red crab fishery. The controlled access system may have negative social impacts on the vessels excluded from participating in the directed red crab fishery. Depending upon the option selected and the level of the trip limit set for the directed red crab fishery, trip limits may be expected to have a positive social impact on members of the red crab fishery by mitigating some of the potential negative social impacts associated with a hard TAC. These potential negative social impacts will not be mitigated in Alternative 4, so it may have a more negative social impact than Alternative 1.

Compared to Alternative 10, in what ways might this alternative have a more positive social/cultural impact?

Butchering/processing restrictions are expected to have positive social impacts on the fishermen involved in the directed red crab fishery unless the most restrictive option, a total prohibition on all butchering and processing at sea, is selected. The gear requirements options offer potential social benefits, resulting from the proposed prohibition on all fishing gear other than traps. A controlled access system will provide positive social impacts on the vessels authorized to participate in the directed red crab fishery. Days-at-sea (DAS) limits are expected to provide positive social benefits to the fishermen involved in the directed red crab fishery by preventing a derby fishery and allowing them more flexibility and stability, while reducing uncertainty. Overall, implementing a management program for the red crab fishery that reduces the probability of overfishing and reduces the likelihood of the fishery becoming overcapitalized will have an overall positive effect on the social and cultural aspects of the fishery.

Compared to Alternative 10, in what ways might this alternative have a more negative social/cultural impact?

If the most restrictive option for butchering/processing restrictions is selected, this alternative has the potential to cause negative social impacts on some members of the directed red crab fishery. The controlled access system may have negative social impacts on the vessels excluded from participating in the directed red crab fishery.

5.4.5.6 Impacts of the Alternative on Protected Species

DAS has the benefit of reducing the possibility of derby fishing as vessels can spread out their effort through the season, although there is no limit on the amount of effort during the spring high use of the continental shelf edge by endangered large whales and the leatherback sea turtle. Trap limits are also beneficial for protected species as it caps the amount of gear that can be set for each vessel. Incidental catch limits will serve to limit growth of non-directed red crab fisheries such as offshore lobster along the continental shelf edge. The reporting requirement will provide additional information regarding the seasonal and area distribution of red crab fishing effort to allow managers to better assess the actual overlap of the fishery with protected species. The gear requirements proposed would not provide any additional protection beyond what is already provided under the MMPA regulations that implement the ALWTRP. The requirement for males only and the butchering/processing at-sea will not provide any protection for protected species.

Using DAS with a target TAC limits will provide adequate control on the growth of the fishery, thus curbing uncontrolled growth that would result in more fixed gear being set in high use waters for protected species, namely the endangered sperm whale and other odontocetes protected under the MMPA; as well as migratory or occasional foraging habitat for the endangered right, humpback, fin, blue and sei whales and the endangered leatherback sea turtle. Since the level of TAC, trap limits, and incidental catch limits are not yet chosen, we cannot assess the protected species effects with respect to Alternative 1. However, implementation of an effort-capping scheme will provide more protection than Alternative 10.

5.4.6 Alternative 5: Target TAC with Days-at-Sea and Trip Limits

This is the Council's preferred alternative. The preferred alternative (like Alternative 4) proposes to implement a set of management measures to control effort in the fishery primarily through the allocation of DAS to all vessels authorized to participate in the directed red crab fishery, with the addition of trip limits. Alternative 5 differs from Alternative 1 by including options for a male-only fishery, butchering/processing restrictions, a controlled access system and days-at-sea limits. Alternative 5 has a target TAC instead of the hard TAC in Alternative 1. Trip limits and days-at-sea are two measures for controlling fishing effort and fishing mortality. Alternative 10, the no action alternative, includes no management measures, so all the measures proposed in Alternative 5 differ from Alternative 10.

5.4.6.1 Biological and Ecological Impacts of the Alternative on Red Crab

Compared to Alternative #1, in what ways might this Alternative have a more positive effect on red crabs?

This has all the advantages of Alternative 4, plus with trip limits in place, recovery ratios associated with different amounts of processing can be used to constrain each trip to have roughly the same maximum number of crabs (i.e., place an upper limit on mortality per trip).

A trip limit and a limit on days-at-sea per vessel can serve along with the target TAC to control fishing effort, catch per trip, and annual catch. These will tend to spread out the effort, because each vessel in the fishery will be assured of a certain amount of time to fish (days-at-sea) and, assuming the trip limit is low enough, numerous trips will be necessary to land the target TAC. Spreading out the catch over time is probably less of a disturbance to the red crab population, especially to the mating system.

Compared to Alternative #1, in what ways might this Alternative have a more negative effect on red crabs?

The days-at-sea measure is a way of managing fishing effort to try to achieve the target TAC. The calculation of days-at-sea per vessel must be completed before the fishing year, and the calculation requires assumptions about the number of vessels, their average catch per trip, and the average days per trip. A further complication is that the days-at-sea for each red crab vessel might have to be estimated taking into account

different types of vessels with different amounts of crab processing. Because the calculation of days-at-sea is indirect, the realized catch after one year using all the days-at-sea might over- or under-shoot the target TAC. This is different from a hard TAC, where the fishery closes as soon as the hard TAC is taken. It should be expected that if both a target TAC and days-at-sea are implemented, the target TAC will have to be adjusted each year to account for the previous year's difference between the realized and target catch. Choosing the right number of days-at-sea to achieve the target TAC is more difficult if there are changes over time in fishing gear, hold capacity, or other fishing regulations (e.g., trip limits).

Compared to Alternative #10, in what ways might this Alternative have a more positive effect on red crabs?

This has all the advantages of Alternative 4, plus with trip limits in place, recovery ratios associated with different amounts of processing can be used to constrain each trip to have roughly the same maximum number of crabs (i.e., place an upper limit on mortality per trip).

A trip limit and a limit on days-at-sea per vessel can serve along with the target TAC to control fishing effort, catch per trip, and annual catch. These will tend to spread out the effort, because each vessel in the fishery will be assured of a certain amount of time to fish (days-at-sea) and, assuming the trip limit is low enough, numerous trips will be necessary to land the target TAC. Spreading out the catch over time is probably less of a disturbance to the red crab population, especially to the mating system.

Compared to Alternative #10, in what ways might this Alternative have a more negative effect on red crabs?

There are no conditions under which this alternative would be expected to have more negative effects on red crabs than Alternative 10.

5.4.6.2 Ecological Impacts of the Alternative on Other Species and Communities

There are no expected differences in the ecological impacts on other species or their communities between this management alternative and the first baseline, Alternative 1, the emergency action alternative. The only difference in the ecological impacts on other species or their communities expected between this management alternative and the second baseline, Alternative 10, the no action alternative, is that associated with the prohibition on all fishing gear types other than traps in the directed red crab fishery, which would be expected to confer benefits to other species and their communities by preventing the use of mobile gear such as otter trawls and dredges.

5.4.6.3 Impacts of the Alternative to Essential Fish Habitat

The relative impacts to essential fish habitat (EFH) of each management alternative under consideration are compared against those of two baselines: Alternative 1, the emergency action alternative, and Alternative 10, the no action alternative.

The only management measures under consideration with any potential relevance to impacts to the EFH of any managed species that may be associated with the directed red crab fishery are the proposed trap limits and the proposed gear restrictions. Both of these measures are proposed in this alternative as well as in Alternative 1, the emergency action baseline. Thus, there are no expected differences between this management alternative and the first baseline. The no action alternative, Alternative 10, by definition would not include any type of trap limit or gear restrictions. This alternative is less likely to result in any impacts to EFH than is the no action alternative, thus this alternative is expected to have a more positive effect on the EFH of managed species than would the second baseline.

5.4.6.4 Economic Impacts of the Alternative on the Fishery

The preferred alternative would be exactly the same as the previous alternative, with the addition of differential trip limits. If trip limits were equal across all vessels, it would force each trip taken by a red crab vessel to be roughly equivalent. Equal trip limits would again contribute to inefficiency in the red crab fleet, restricting some vessels more than others. This could lead to dissatisfaction and disruption of the relationship that exists among members of the red crab fleet. If the calculation of days at sea is accurate, this measure should not be necessary. Because there is likely to be some unknown margin of error in the calculation of DAS to be allocated to each vessel, a trip limit can serve as an additional control on fishing effort. One justification for inclusion of the trip limits into the preferred alternative was so that the transition between the emergency action period and the implementation of the final FMP would be smooth. Due to the administrative burden of implementing a DAS program, there would be a short lapse in time before the complete FMP was implemented, whereas the trip limit could take effect with the initial implementation of the FMP. A target TAC should not promote a derby fishery. The calculation of DAS can be adjusted on an annual basis in response to changing stock conditions and better data. This will result in better estimates of the amount of fish likely to be harvested and more accurate allocation of DAS to meet the objectives.

Differential trip limits will be based on each vessel's highest trip on record prior to the control date. This form of trip limit constitutes a limit on fleet capacity, without creating vessel safety concerns. It also allows each vessel to operate in the most economical way, while still enforcing restraint. Under the preferred alternative, each qualifying vessel will maintain their same competitive position relative to each other, and the total fleet will be constrained to meet the conservation objectives.

Since the calculation of DAS works from a target TAC, it provides less tight control over the level of catch than a hard TAC. Choosing the right number of days-at-sea to achieve the target TAC is more difficult if there are changes over time in fishing gear, hold capacity, or other fishing regulations (e.g., trip limits). Under the preferred alternative, the use of differential trip limits, versus equal trip limits, will allow for the benefits of an effort reduction program to occur.

Data would be gathered which would enable future management actions to use

more comprehensive, reliable, and timely information on the fishery. This alternative would prevent a derby fishery, and allows a more predictable level of supplies to market (retailers and consumers) and to the processors.

5.4.6.5 Social/Cultural Impacts of the Alternative

Compared to Alternative 1, in what ways might this alternative have a more positive social/cultural impact?

The positive effects of this alternative compared to Alternative 1 are the same as for Alternative 4.

Compared to Alternative 1, in what ways might this alternative have a more negative social/cultural impact?

The negative effects of this alternative compared to Alternative 1 are the same as for Alternative 4, with the exception of those impacts associated with trip limits.

Compared to Alternative 10, in what ways might this alternative have a more positive social/cultural impact?

The positive effects of this alternative compared to Alternative 10 are the same as for Alternative 4 with the addition of trip limits which may be expected to have a positive social impact on members of the red crab fishery by mitigating some of the potential negative social impacts associated with a hard TAC.

Compared to Alternative 10, in what ways might this alternative have a more negative social/cultural impact?

The negative effects of this alternative compared to Alternative 10 are the same as for Alternative 4.

5.4.6.6 Impacts of the Alternative on Protected Species

DAS and trip limits have the benefit of reducing the possibility of derby fishing as vessels can spread out their effort through the season, although there is no limit on the amount of effort during the spring high use of the continental shelf edge by endangered large whales and the leatherback sea turtle. The incidental catch limit set at 500 pounds will serve to limit growth of non-directed red crab fisheries such as the offshore lobster fishery along the continental shelf edge. Establishing a limit of 600 traps is also beneficial for protected species as it caps the amount of gear that can be set for each vessel at current levels. The reporting requirement will provide additional information regarding the seasonal and area distribution of red crab fishing effort to allow managers to better assess the actual overlap of the fishery with protected species. The gear requirements proposed would not provide any additional protection beyond what is already provided under the MMPA regulations that implement the ALWTRP, except for the buoy marking requirement that will assist in identification of gear retrieved in an entanglement. The requirement for males only and the prohibition on processing at-sea

will not provide any additional protection for protected species.

Adding the combination of a 75,000 pound trip limit to a DAS allocation between 130 and 160, with a target TAC of 5,928,000 pounds (1999 level), should provide adequate control on the growth of the fishery. Uncontrolled growth that would result in more fixed gear being set in high use waters for protected species was seen as detrimental to the endangered sperm whale and other odontocetes protected under the MMPA, as well as migratory or occasional foraging habitat for the endangered right, humpback, fin, blue and sei whales and the endangered leatherback sea turtle.

The level of TAC will vary depending on resource status and previous landings, and the trap limits will be set at the same level as the emergency regulations. Although the incidental catch limit will be higher than in the emergency regulations, the overall benefit to protected species should be the same or greater than Alternative 1 due to the effect of DAS mitigating the derby fishing affect upon the season opening on March 1. Implementation of the preferred alternative will provide more protection than Alternative 10.

5.4.7 Alternative 6: Trip Limits with Authorized Number of Trips

This non-preferred alternative proposed to implement a set of management measures to control effort in the fishery through the use of a selective trip limit program and an authorized number of annual fishing trips for each vessel authorized to participate in the directed red crab fishery. Alternative 6 differs from Alternative 1 by including options for a male-only fishery, butchering/processing restrictions, and a controlled access system, but does not include options for a TAC. Alternative 10, the no action alternative, includes no management measures, so all the measures proposed in Alternative 6 differ from Alternative 10.

5.4.7.1 Biological and Ecological Impacts of the Alternative on Red Crab

Compared to Alternative #1, in what ways might this Alternative have a more positive effect on red crabs?

By limiting the landings to males, females will be protected from direct fishing mortality. Females still might incur high handling mortality. We do not know how high handling mortality is, so traps should be designed to reduce the capture of crabs that must be returned or that are too small to have much meat yield. Protecting the females will promote population growth, but this will occur only if sufficient numbers of large males are left in the population.

The amount of processing allowed will affect whether this alternative can be put into practice successfully. The most extreme hypothetical case would be if at-sea processing was eliminated, and only whole, male crabs could be landed. Resulting positive effects would include the ability to monitor compliance with the male-only measure and protection of females and small males. In addition, this might limit the number of crabs taken per trip because the ships' storage areas would fill more quickly per capita of crab landed. In contrast, if processing at sea were allowed with only minor

restrictions, then it would not be possible to monitor what was being landed or to protect females or smaller males.

Controlled access will limit the number of vessels harvesting red crab and make it easier to monitor landings. Reporting requirements will also support monitoring and enforcement. If the number of trips allowed is computed correctly, then the annual catch should not exceed the annual catch that would be achieved with a hard TAC. In fact, the total catch under this option is likely to be less than what would occur with a hard TAC. Using the regulations under the emergency period as an example, the fishery operated under a trip limit and a hard TAC. NMFS tracked per trip landings using the required interactive voice reporting (IVR) system and developed projections as to when the fishery was likely to reach the TAC based on current landings. Using this process, NMFS determined that the fishery would reach the emergency period TAC on or shortly after August 17, 2001. On August 8, NMFS announced that the fishery would be closed as of August 17 (the earliest the projections indicated the TAC would be reached). By the time the fishery closed on August 17, however, the red crab fishery had landed 2.84 million pounds, a 13.6% overage.

Under the allocated number of trips program, vessels would have a trip limit and a limited number of fishing trips to take during the fishing year. The full target yield would only be reached if all vessels landed 100% of the trip limit on all trips and took all trips allocated to them. Again, using the emergency period as an example to suggest why this may be unlikely, the results of the per trip landings indicate that 21% of all trips landed less than 75% of the trip limit, 36.5% of the trips landed less than 90% of the trip limit, and over half (54%) landed less than 95% of the trip limit. If we assume that the total number of trips made (52) had been the total allocated and that this number of trips in conjunction with the 65,000 pound trip limit combined to represent the target yield for the fishery (3.38 million pounds), then the fishery would only have landed 84% of the target yield. This suggests that this management approach (trip limits and an allocated number of trips per vessel) is a more conservative approach to managing the fishery at or near target yield levels than a hard TAC approach (total landings = 16% *under* the TAC versus 13.6% *over* the TAC).

With trip limits in place, recovery ratios associated with different amounts of processing can be used to constrain each trip to have roughly the same maximum number of crabs (i.e., place an upper limit on mortality per trip). The trip limit can work along with the butchering/processing restriction and the male-only requirement to limit the size range, sex and number of red crabs that are landed per trip. This combination of measures will spread the catch out across seasons (reduce the derby-type fishery), limit the catch to large males which should allow females to continue reproducing, and allow the catch to be monitored for stock assessment.

Compared to Alternative #1, in what ways might this Alternative have a more negative effect on red crabs?

Without a hard TAC there will be no direct way to stop harvesting if the landings exceed the estimated long term annual yield (MSY). This alternative relies on other

measures (e.g., number of trips, trip limits, males only, processing restrictions) to slow down the landings taken during the year. It may be difficult to correctly estimate the number of trips per vessel, especially if there are different classes of vessels with different amounts of processing.

Compared to Alternative #10, in what ways might this Alternative have a more positive effect on red crabs?

By limiting the landings to males, females will be protected from direct fishing mortality. Females still might incur high handling mortality. We do not know how high handling mortality is, so traps should be designed to reduce the capture of crabs that must be returned or that are too small to have much meat yield. Protecting the females will promote population growth, but this will occur only if sufficient numbers of large males are left in the population.

The amount of processing allowed will affect whether this alternative can be put into practice successfully. The most extreme hypothetical case would be if at-sea processing was eliminated, and only whole, male crabs could be landed. Resulting positive effects would include the ability to monitor compliance with the male-only measure and protection of females and small males. In addition, this might limit the number of crabs taken per trip because the ships' storage areas would fill more quickly per capita of crab landed. In contrast, if processing at sea were allowed with only minor restrictions, then it would not be possible to monitor what was being landed or to protect females or smaller males.

With trip limits in place, recovery ratios associated with different amounts of processing can be used to constrain each trip to have roughly the same maximum number of crabs (i.e., place an upper limit on mortality per trip).

Controlled access will limit the number of vessels harvesting red crab and make it easier to monitor landings. Reporting requirements will also support this. If the number of trips allowed is computed correctly, then the annual catch should not exceed the annual catch that would be achieved with a hard TAC.

The trip limit can work along with the butchering/processing restriction and the male-only requirement to limit the size range, sex and number of red crabs that are landed per trip. This combination of measures will spread the catch out across seasons (reduce the derby-type fishery), limit the catch to large males which should allow females to continue reproducing, and allow the catch to be monitored for stock assessment.

Incidental catch limits will prevent excessive red crab landings by vessels from other fisheries. Trap limits can limit catch rates and gear restrictions can allow small red crabs to escape from traps. Reporting requirements for each trip will allow the catch to be monitored accurately during the year.

Compared to Alternative #10, in what ways might this Alternative have a more negative effect on red crabs?

There are no conditions under which this alternative would be expected to have more negative effects on red crabs than Alternative 10.

5.4.7.2 Ecological Impacts of the Alternative on Other Species and Communities

There are no expected differences in the ecological impacts on other species or their communities between this management alternative and the first baseline, Alternative 1, the emergency action alternative. The only difference in the ecological impacts on other species or their communities expected between this management alternative and the second baseline, Alternative 10, the no action alternative, is that associated with the prohibition on all fishing gear types other than traps in the directed red crab fishery, which would be expected to confer benefits to other species and their communities by preventing the use of mobile gear such as otter trawls and dredges.

5.4.7.3 Impacts of the Alternative to Essential Fish Habitat

The relative impacts to essential fish habitat (EFH) of each management alternative under consideration are compared against those of two baselines: Alternative 1, the emergency action alternative, and Alternative 10, the no action alternative.

The only management measures under consideration with any potential relevance to impacts to the EFH of any managed species that may be associated with the directed red crab fishery are the proposed trap limits and the proposed gear restrictions. Both of these measures are proposed in this alternative as well as in Alternative 1, the emergency action baseline. Thus, there are no expected differences between this management alternative and the first baseline. The no action alternative, Alternative 10, by definition would not include any type of trap limit or gear restrictions. This alternative is less likely to result in any impacts to EFH than is the no action alternative, thus this alternative is expected to have a more positive effect on the EFH of managed species than would the second baseline.

5.4.7.4 Economic Impacts of the Alternative on the Fishery

Alternative 6 would also implement many of the same measures as previous alternatives, but the principle mechanism to control effort in the fishery would be the use of a specified trip limit and an authorized number of potential fishing trips. The trip limit could be set equal for all vessels, or could allow vessels to declare into a certain category of trip limit. Vessels would be authorized different numbers of potential trips depending on the trip limit category into which they declare.

Vessels would be able to know, up front, what they could land per trip and how many trips they could take. Individual vessels would have the opportunity to plan for alternative sources of revenue. Even though a TAC is not specified for this alternative, the calculation of number of trips and a trip limit would have to take the total catch into account. Depending on the level of the trip limit, it could restrict vessels to operate in a very inefficient manner. Slightly better, differential trip limits may allow one class of vessels to take advantage of their increased hold capacity. It would allow larger vessels to participate at a higher level of landings. Depending on the number of vessels allowed

to participate, each vessel could end up with a trip limit and number of trips that may make it unprofitable to participate in the fishery. Individual vessel revenues would be dependent on these factors.

Controlled access will limit the participation of vessels harvesting red crab. From society's point of view, this means there is a reduction in the accumulation of excess capital and lower costs. Those other resources (who are not in the fishery) can be directed elsewhere.

Trip limits would not be as restrictive as under Alternative 1 for some vessels under the differential trip limit option. This alternative would allow different size classes of vessels to participate at levels more appropriate for them. Vessels would know up front how many trips they could take and could plan their fishing activity accordingly.

There may be administrative problems associated with the implementation of this alternative. It will be difficult to correctly estimate the number of trips per vessel, especially if there are different classes of vessels with different amounts of processing.

5.4.7.5 Social/Cultural Impacts of the Alternative

Compared to Alternative 1, in what ways might this alternative have a more positive social/cultural impact?

Butchering/processing restrictions are expected to have positive social impacts on the fishermen involved in the directed red crab fishery unless the most restrictive option, a total prohibition on all butchering and processing at sea, is selected. A controlled access system will provide positive social impacts on the vessels authorized to participate in the directed red crab fishery. The lack of a TAC for this alternative eliminates the potential negative social impacts associated with this type of measure, principally the creation of a derby-style fishery.

Compared to Alternative 1, in what ways might this alternative have a more negative social/cultural impact?

If the most restrictive option for butchering/processing restrictions is selected, this alternative has the potential to cause negative social impacts on some members of the directed red crab fishery. The controlled access system may have negative social impacts on the vessels excluded from participating in the directed red crab fishery. There are no other conditions under which Alternative 6 would be expected to have more negative social or cultural impacts than Alternative 1.

Compared to Alternative 10, in what ways might this alternative have a more positive social/cultural impact?

Butchering/processing restrictions are expected to have positive social impacts on the fishermen involved in the directed red crab fishery unless the most restrictive option, a total prohibition on all butchering and processing at sea, is selected. The gear requirements options offer potential social benefits, resulting from the proposed

prohibition on all fishing gear other than traps. A controlled access system will provide positive social impacts on the vessels authorized to participate in the directed red crab fishery. Overall, implementing a management program for the red crab fishery that reduces the probability of overfishing and reduces the likelihood of the fishery becoming overcapitalized will have an overall positive effect on the social and cultural aspects of the fishery.

Compared to Alternative 10, in what ways might this alternative have a more negative social/cultural impact?

If the most restrictive option for butchering/processing restrictions is selected, this alternative has the potential to cause negative social impacts on some members of the directed red crab fishery. The controlled access system may have negative social impacts on the vessels excluded from participating in the directed red crab fishery.

5.4.7.6 Impacts of the Alternative on Protected Species

Controlling both the number of trips and the amount of catch per trip would cap the effort, but does not limit the amount of effort during the spring high use of the continental shelf edge by endangered large whales and the leatherback sea turtle. Trap limits are also beneficial for protected species as it caps the amount of gear that can be set for each vessel. Incidental catch limits will serve to limit growth of non-directed red crab fisheries such as offshore lobster along the continental shelf edge. The reporting requirement will provide additional information regarding the seasonal and area distribution of red crab fishing effort to allow managers to better assess the actual overlap of the fishery with protected species. The gear requirements proposed would not provide any additional protection beyond what is already provided under the MMPA regulations that implement the ALWTRP. The requirement for males only and the processing at sea restrictions will not provide any protection for protected species.

Trip limits by themselves will provide adequate control on the growth of the fishery, thus curbing uncontrolled growth that would result in more fixed gear being set in high use waters for protected species, namely the endangered sperm whale and other odontocetes protected under the MMPA; as well as migratory or occasional foraging habitat for the endangered right, humpback, fin, blue and sei whales and the endangered leatherback sea turtle. Since the level of TAC, trip limits, trap limits, and incidental catch limits are not yet chosen, we cannot assess the protected species effects with respect to Alternative 1. However, implementation of an effort-capping scheme will provide more protection than Alternative 10.

5.4.8 **Alternative 7: All Possible Measures**

This non-preferred alternative proposed to implement a set of management measures to control effort in the fishery by including all possible management measures with the exception of an IVQ system. Alternative 7 differs from Alternative 1 by including options for a minimum size, a male-only fishery, butchering/processing restrictions, a controlled access system and days-at-sea limits. Trip limits and days-at-sea

are two measures for controlling fishing effort and fishing mortality. Minimum size and males-only are ways of controlling what segment of the population is exposed to fishing mortality. Alternative 10, the no action alternative, includes no management measures, so all the measures proposed in Alternative 7 differ from Alternative 10.

5.4.8.1 Biological and Ecological Impacts of the Alternative on Red Crab

Compared to Alternative #1, in what ways might this Alternative have a more positive effect on red crabs?

By limiting the landings to large males, females and small males will be protected from direct fishing mortality. Females and small males still might incur high handling mortality. We do not know how high handling mortality is, so traps should be designed to reduce the capture of crabs that must be returned or that are too small to have much meat yield. Protecting the females will promote population growth, but this will occur only if sufficient numbers of reproductive males are left in the population.

The amount of processing allowed will affect whether this alternative can be put into practice successfully. The most extreme hypothetical case would be if at-sea processing was eliminated, and only whole, large, male crabs could be landed. Resulting positive effects would include the ability to monitor compliance with the size and male-only measure and protection of females and small males. In addition, this might limit the number of crabs taken per trip because the ships' storage areas would fill more quickly per capita of crab landed. In contrast, if processing at sea were allowed with only minor restrictions, then it would not be possible to monitor what was being landed or to protect females or smaller males.

With trip limits in place, recovery ratios associated with different amounts of processing could be used to constrain each trip to have roughly the same maximum number of large, male crabs (i.e., place an upper limit on mortality per trip). Controlled access will limit the number of vessels harvesting red crab and make it easier to monitor and enforce the TAC. Reporting requirements will also support this.

A trip limit and a limit on days-at-sea per vessel can serve along with the hard TAC to control fishing effort, catch per trip, and annual catch. These will tend to spread out the effort, because each vessel in the fishery will be assured of a certain amount of time to fish (days-at-sea) and, assuming the trip limit is low enough, numerous trips will be necessary to land the TAC. Spreading out the catch over time is probably less of a disturbance to the red crab population, especially to the mating system.

If a hard TAC were in place along with days-at-sea and trip limits, then there would be little chance that the actual landings would overshoot the TAC. Without a minimum size limit, as is included in this alternative, removing too many large males from the population could disturb courtship and mating (Elner et al. 1987), which may reduce female fecundity. Imposing a minimum size limit would be the most direct way to maintain males that are capable of mating with the largest females.

Compared to Alternative #1, in what ways might this Alternative have a more

negative effect on red crabs?

There are no conditions under which this alternative would have a more negative effect on red crabs than Alternative 1.

Compared to Alternative #10, in what ways might this Alternative have a more positive effect on red crabs?

By limiting the landings to large males, females and small males will be protected from direct fishing mortality. Females and small males still might incur high handling mortality. We do not know how high handling mortality is, so traps should be designed to reduce the capture of crabs that must be returned or that are too small to have much meat yield. Protecting the females will promote population growth, but this will occur only if sufficient numbers of reproductive males are left in the population.

The amount of processing allowed will affect whether this alternative can be put into practice successfully. The most extreme hypothetical case would be if at-sea processing was eliminated, and only whole, large, male crabs could be landed. Resulting positive effects would include ability to monitor compliance with the size and male-only measure and protection of females and small males. In addition, this might limit the number of crabs taken per trip because the ships' storage areas would fill more quickly per capita of crab landed. In contrast, if processing at sea were allowed with only minor restrictions, then it would not be possible to monitor what was being landed or to protect females or smaller males.

With trip limits in place, recovery ratios associated with different amounts of processing could be used to constrain each trip to have roughly the same maximum number of large, male crabs (i.e., place an upper limit on mortality per trip). Controlled access will limit the number of vessels harvesting red crab and make it easier to monitor and enforce the TAC. Reporting requirements will also support this.

A trip limit and a limit on days-at-sea per vessel can serve along with the hard TAC to control fishing effort, catch per trip, and annual catch. These will tend to spread out the effort, because each vessel in the fishery will be assured of a certain amount of time to fish (days-at-sea) and, assuming the trip limit is low enough, numerous trips will be necessary to land the TAC. Spreading out the catch over time is probably less of a disturbance to the red crab population, especially to the mating system.

If a hard TAC were in place along with days-at-sea and trip limits, then there would be little chance that the actual landings would overshoot the TAC. Incidental catch limits will prevent excessive red crab landings by vessels from other fisheries. Trap limits can limit catch rates and gear restrictions can allow small red crabs to escape from traps. A TAC with reporting requirements for each trip will reduce the probability of overfishing.

Compared to Alternative #10, in what ways might this Alternative have a more negative effect on red crabs?

There are no conditions under which this alternative would be expected to have

more negative effects on red crabs than Alternative 10.

5.4.8.2 Ecological Impacts of the Alternative on Other Species and Communities

There are no expected differences in the ecological impacts on other species or their communities between this management alternative and the first baseline, Alternative 1, the emergency action alternative. The only difference in the ecological impacts on other species or their communities expected between this management alternative and the second baseline, Alternative 10, the no action alternative, is that associated with the prohibition on all fishing gear types other than traps in the directed red crab fishery, which would be expected to confer benefits to other species and their communities by preventing the use of mobile gear such as otter trawls and dredges.

5.4.8.3 Impacts of the Alternative to Essential Fish Habitat

The relative impacts to essential fish habitat (EFH) of each management alternative under consideration are compared against those of two baselines: Alternative 1, the emergency action alternative, and Alternative 10, the no action alternative.

The only management measures under consideration with any potential relevance to impacts to the EFH of any managed species that may be associated with the directed red crab fishery are the proposed trap limits and the proposed gear restrictions. Both of these measures are proposed in this alternative as well as in Alternative 1, the emergency action baseline. Thus, there are no expected differences between this management alternative and the first baseline. The no action alternative, Alternative 10, by definition would not include any type of trap limit or gear restrictions. This alternative is less likely to result in any impacts to EFH than is the no action alternative, thus this alternative is expected to have a more positive effect on the EFH of managed species than would the second baseline.

5.4.8.4 Economic Impacts of the Alternative on the Fishery

Alternative 7 includes all possible management measures except for an IVQ system. This alternative relies on so many different measures, it is difficult to determine the degree of impact from any one measure and therefore be difficult to adjust to changing stock conditions. The effectiveness of a days-at-sea program is greater if other measures are not also used to undermine its effectiveness. Many of these measures would make it inefficient to operate in the fishery, raising costs, without the benefit of additional revenue. If all measures are used as a way to limit catch or effort, the entire fleet would operate inefficiently; the increased costs would be passed on to the consumer and no one would benefit. If all of the measures of Alternative 7 are not constraining to the behavior of the fleet, then this alternative would have economic benefits similar to those of the preferred alternative. With all options constraining, this alternative would be very difficult to enforce, as well as costly and difficult to administer.

Compared to Alternatives 1 and 10, the only positive economic effect is due to controlled access. From society's point of view, this means there is a reduction in the accumulation of excess capital and lower costs. Those other resources (who are not in

the fishery) can be directed elsewhere. Alternative 1 would also gather data which would enable future management actions to use more comprehensive, reliable, and timely information on the fishery. Historic participants may be able to remain in the fishery, even if they have to operate in a less efficient manner.

Alternative 7 includes all options from the preferred alternative with the addition of a minimum size. Public comments supported the idea that market control over the minimum size of red crabs is adequate to prevent the landings of small crabs. If that situation is believed to change, then future frameworks can implement a minimum size.

5.4.8.5 Social/Cultural Impacts of the Alternative

Compared to Alternative 1, in what ways might this alternative have a more positive social/cultural impact?

Butchering/processing restrictions are expected to have positive social impacts on the fishermen involved in the directed red crab fishery unless the most restrictive option, a total prohibition on all butchering and processing at sea, is selected. A controlled access system will provide positive social impacts on the vessels authorized to participate in the directed red crab fishery. Days-at-sea (DAS) limits are expected to provide positive social benefits to the fishermen involved in the directed red crab fishery by preventing a derby fishery and allowing them more flexibility and stability, while reducing uncertainty.

Compared to Alternative 1, in what ways might this alternative have a more negative social/cultural impact?

If the most restrictive option for butchering/processing restrictions is selected, this alternative has the potential to cause negative social impacts on some members of the directed red crab fishery. The controlled access system may have negative social impacts on the vessels excluded from participating in the directed red crab fishery. There are no other conditions under which Alternative 7 would be expected to have more negative social or cultural impacts than Alternative 1.

Compared to Alternative 10, in what ways might this alternative have a more positive social/cultural impact?

Butchering/processing restrictions are expected to have positive social impacts on the fishermen involved in the directed red crab fishery unless the most restrictive option, a total prohibition on all butchering and processing at sea, is selected. The gear requirements options offer potential social benefits, resulting from the proposed prohibition on all fishing gear other than traps. A controlled access system will provide positive social impacts on the vessels authorized to participate in the directed red crab fishery. DAS limits are expected to provide positive social benefits to the fishermen involved in the directed red crab fishery by preventing a derby fishery and allowing them more flexibility and stability, while reducing uncertainty. Overall, implementing a management program for the red crab fishery that reduces the probability of overfishing and reduces the likelihood of the fishery becoming overcapitalized will have an overall

positive effect on the social and cultural aspects of the fishery.

Compared to Alternative 10, in what ways might this alternative have a more negative social/cultural impact?

If the most restrictive option for butchering/processing restrictions is selected, this alternative has the potential to cause negative social impacts on some members of the directed red crab fishery. The controlled access system may have negative social impacts on the vessels excluded from participating in the directed red crab fishery.

5.4.8.6 Impacts of the Alternative on Protected Species

Using all the possible measures will provide adequate control on the growth of the fishery, thus curbing uncontrolled growth that would result in more fixed gear being set in high use waters for protected species, namely the endangered sperm whale and other odontocetes protected under the MMPA; as well as migratory or occasional foraging habitat for the endangered right, humpback, fin, blue and sei whales and the endangered leatherback sea turtle. Trap limits are also beneficial for protected species as it caps the amount of gear that can be set for each vessel. However, these measures do not limit the amount of effort during the spring high use of the continental shelf edge by endangered large whales and the leatherback sea turtle. Incidental catch limits will serve to limit growth of non-directed red crab fisheries such as offshore lobster along the continental shelf edge. The reporting requirement will provide additional information regarding the seasonal and area distribution of red crab fishing effort to allow managers to better assess the actual overlap of the fishery with protected species. The gear requirements proposed would not provide any additional protection beyond what is already provided under the MMPA regulations that implement the ALWTRP. The requirement for males only and the butchering/processing at-sea will not provide any protection for protected species.

Since the level of TAC, DAS scheme to be used, trip limits, trap limits, and incidental catch limits are not yet chosen, we cannot assess the protected species effects with respect to Alternative 1. However, implementation of an effort-capping scheme will provide more protection than Alternative 10.

5.4.9 **Alternative 8: IVQ with Controlled Access**

This non-preferred alternative proposed to implement a set of management measures to control effort in the fishery primarily through a specific allocation of quota to each vessel authorized to participate in the directed red crab fishery through the controlled access program. Alternative 8 differs from Alternative 1 by including options for a controlled access system and an individual vessel quota (IVQ) system, but does not include options for trap limits, a TAC, or trip limits. Unlike previous alternatives, this one has no restrictions about crab size or gender, trip limits or days-at-sea. Alternative 10, the no action alternative, includes no management measures, so all the measures proposed in Alternative 8 differ from Alternative 10.

5.4.9.1 Biological and Ecological Impacts of the Alternative on Red Crab

Compared to Alternative #1, in what ways might this Alternative have a more positive effect on red crabs?

Controlled access will limit the number of vessels harvesting red crab and make it easier to monitor and enforce the individual vessel quotas, whose sum would be equivalent to a hard TAC. Reporting requirements will also support this. With individual quotas, vessels are less likely to harvest in the manner of a fishing derby. This could reduce the risk that the fishery would disturb the red crab mating process.

Compared to Alternative #1, in what ways might this Alternative have a more negative effect on red crabs?

Any size or gender may be harvested. Without measures to limit what types of crabs may be harvested, the population sex ratio and mating system could become perturbed, which could reduce mating success. Imposing a minimum size limit would be the most direct way to maintain males that are capable of mating with the largest females in the population.

There are no restrictions on processing, but it would be consistent with the other alternatives to utilize recovery ratios to convert processed weights into whole weights. If extensive processing were allowed at sea, it would not be possible to monitor what was being landed or to protect females or smaller males.

Without trip limits, vessels could potentially make much larger catches during a single trip. Removal of a large number of large crabs at a single time might reduce population growth rate more than if the catch was more spread out over time and space.

Compared to Alternative #10, in what ways might this Alternative have a more positive effect on red crabs?

Controlled access will limit the number of vessels harvesting red crab and make it easier to monitor and enforce the individual vessel quotas, whose sum would be equivalent to a hard TAC. Reporting requirements will also support this. With individual quotas, vessels are less likely to harvest in the manner of a fishing derby. This could reduce the risk that the fishery would disturb the red crab mating process.

Incidental catch limits will prevent excessive red crab landings by vessels from other fisheries. Gear restrictions can allow small red crabs to escape from traps. Reporting requirements for each trip will allow total landings to be monitored.

Compared to Alternative #10, in what ways might this Alternative have a more negative effect on red crabs?

There are no conditions under which this alternative would be expected to have more negative effects on red crabs than Alternative 10.

5.4.9.2 Ecological Impacts of the Alternative on Other Species and Communities

There are no expected differences in the ecological impacts on other species or their communities between this management alternative and the first baseline, Alternative 1, the emergency action alternative. The only difference in the ecological impacts on other species or their communities expected between this management alternative and the second baseline, Alternative 10, the no action alternative, is that associated with the prohibition on all fishing gear types other than traps in the directed red crab fishery, which would be expected to confer benefits to other species and their communities by preventing the use of mobile gear such as otter trawls and dredges.

5.4.9.3 Impacts of the Alternative to Essential Fish Habitat

The relative impacts to essential fish habitat (EFH) of each management alternative under consideration are compared against those of two baselines: Alternative 1, the emergency action alternative, and Alternative 10, the no action alternative.

The only management measures under consideration with any potential relevance to impacts to the EFH of any managed species that may be associated with the directed red crab fishery are the proposed trap limits and the proposed gear restrictions. Both of these measures would be proposed in the first baseline, Alternative 1, the emergency action alternative, but only the gear restrictions are proposed in this alternative. Due to the nature of the proposed IVQ system, there is no need to implement any type of trap limit in the red crab fishery. This difference could result in an increase in the number of traps employed in the fishery under this alternative compared to the number of traps that would be employed if trip limits were also implemented. Thus, from the perspective of potential impacts to EFH, this alternative would be expected to have potentially more impact than the first baseline.

The no action alternative, Alternative 10, by definition would not include any type of trap limit or gear restrictions. Because it proposes to implement some form of gear restrictions, including a prohibition on the use of non-trap gear in the directed red crab fishery, this alternative is less likely to result in any impacts to EFH than is the no action alternative. This alternative is expected to have a more positive effect on the EFH of managed species than would the second baseline.

5.4.9.4 Economic Impacts of the Alternative on the Fishery

The next two management alternatives represent options for a form of an IFQ system called an individual vessel quota (IVQ). Alternative 8 would implement both a controlled access system to limit the number of vessels participating in the directed fishery and an individual vessel quota to allocate each vessel an individual percentage based share of the TAC. As the TAC changed from year to year in response to changing stock conditions, the percentage of quota allocated to each vessel would not change, but the amount of quota would change accordingly.

This alternative would provide tighter control over each year's catch than would the control of inputs. Vessels would be able to operate at their peak efficiency, selecting the

least cost combination of inputs. A great degree of freedom and flexibility would be granted to the individual vessel. The supply of red crabs would be consistent throughout the year, maintaining a constant supply to processors, retailers, and consumers.

Controlled access will limit the number of vessels harvesting red crab and make it easier to monitor and enforce the individual vessel quotas, whose sum would be equivalent to a hard TAC. From society's point of view, this means there is a reduction in the accumulation of excess capital and lower costs. Those other resources (who are not in the fishery) can be directed elsewhere. Trip revenue would increase as there would be no limits on the amount of crab landed per trip. Vessels could operate to their full potential and utilize their hold capacity. With individual quotas, vessels are not likely to harvest in the manner of a fishing derby. Data would be gathered which would enable future management actions to use more comprehensive, reliable, and timely information on the fishery.

This alternative would shift a substantial part of the management to a market mechanism, since it eliminates some of the gear, vessels, and processing restrictions that are a greater burden to enforce. This alternative should encourage technological development and innovation. Vessels participating in the directed fishery would have the freedom to choose the most appropriate fishing methods (aside from gear restrictions), fishing times, and strategies.

High-grading could be a problem, although this would be expected to be minimal given the market constraints that already exist in the fishery. The creation of use rights means that some gain and some lose; this creates a redistribution of wealth and has equity implications.

5.4.9.5 Social/Cultural Impacts of the Alternative

Compared to Alternative 1, in what ways might this alternative have a more positive social/cultural impact?

There are some cases of trap limits that may have an adverse social impact on the red crab fishery, and since this alternative does not include trap limits, this potential negative impact is eliminated. A controlled access system will provide positive social impacts on the vessels authorized to participate in the directed red crab fishery. The lack of a TAC for this alternative eliminates the potential negative social impacts associated with this type of measure. The IVQ system is expected to create positive social benefits for the fishermen authorized to participate in the directed red crab fishery due to increased stability and flexibility and reduced uncertainty associated.

Compared to Alternative 1, in what ways might this alternative have a more negative social/cultural impact?

The controlled access system may have negative social impacts on the vessels excluded from participating in the directed red crab fishery. There are no other conditions under which Alternative 8 would be expected to have more negative social or cultural impacts than Alternative 1.

Compared to Alternative 10, in what ways might this alternative have a more positive social/cultural impact?

The gear requirements options offer potential social benefits, resulting from the proposed prohibition on all fishing gear other than traps. A controlled access system will provide positive social impacts on the vessels authorized to participate in the directed red crab fishery. The IVQ system is expected to result in positive social benefits for the fishermen authorized to participate in the directed red crab fishery due to the increased stability and flexibility and reduced uncertainty associated with this type of measure. Implementing a management program for the red crab fishery that reduces the probability of overfishing and reduces the likelihood of an overcapitalized fishery will have an overall positive effect on the social and cultural aspects of the fishery.

Compared to Alternative 10, in what ways might this alternative have a more negative social/cultural impact?

The controlled access system may have negative social impacts on the vessels excluded from participating in the directed red crab fishery. There are no other conditions under which Alternative 8 would be expected to have more negative social or cultural impacts than Alternative 10.

5.4.9.6 Impacts of the Alternative on Protected Species

IVQs used in concert with a controlled access system will reduce the amount of total red crab trap effort. However, there is no limit on the amount of effort during the spring high use of the continental shelf edge by endangered large whales and the leatherback sea turtle. Incidental catch limits will serve to limit growth of non-directed red crab fisheries such as offshore lobster along the continental shelf edge. The reporting requirement will provide additional information regarding the seasonal and area distribution of red crab fishing effort to allow managers to better assess the actual overlap of the fishery with protected species. The gear requirements proposed would not provide any additional protection beyond what is already provided under the MMPA regulations that implement the ALWTRP.

IVQs with the use of a controlled access system to limit the number of vessels participating in the fishery will provide adequate control on the growth of the fishery, thus curbing uncontrolled growth that would result in more fixed gear being set in high use waters for protected species, namely the endangered sperm whale and other odontocetes protected under the MMPA; as well as migratory or occasional foraging habitat for the endangered right, humpback, fin, blue and sei whales and the endangered leatherback sea turtle. Since neither the level of TAC to be applied to the IVQ system, or the controlled access program have not yet been chosen, we cannot assess the protected species effects with respect to Alternative 1. However, implementation of an effort-capping scheme will provide more protection than Alternative 10.

5.4.10 Alternative 9: IVQ Only

This non-preferred alternative proposed to implement a set of management

measures to control effort in the fishery primarily through a specific allocation of quota to all vessels with any history of landing red crabs. Alternative 9 differs from Alternative 1 by including options for an individual vessel quota (IVQ) system, but does not include options for trap limits, a TAC, or trip limits. This alternative has no restrictions about crab size or gender, trip limits or days-at-sea. Alternative 10, the no action alternative, includes no management measures, so all the measures proposed in Alternative 9 differ from Alternative 10.

5.4.10.1 Biological and Ecological Impacts of the Alternative on Red Crab

Compared to Alternative #1, in what ways might this Alternative have a more positive effect on red crabs?

Individual vessel quotas, which sum to the TAC, are easy to track and enforce. Reporting requirements will also support this. Thus, the realized landings will be very close to the TAC. With individual quotas, vessels are less likely to harvest in the manner of a fishing derby. This could reduce the risk that the fishery would disturb the red crab mating process.

Compared to Alternative #1, in what ways might this Alternative have a more negative effect on red crabs?

Any size or gender may be harvested. Without measures to limit what types of crabs may be harvested the population sex ratio and mating system could become perturbed, which could reduce mating success. There are no restrictions on processing, but it would be consistent with the other alternatives to utilize recovery ratios to convert processed weights into whole weights. If processing were allowed at sea, it would not be possible to monitor what was being landed or to protect females or smaller males.

Without trip limits, vessels could potentially make much larger catches during a single trip. Removal of a large number of large crabs at a single time might reduce population growth rate more than if the catch was more spread out over time and space. Without a controlled access system, it would be very difficult to assign individual vessel quotas. Managers would be uncertain about which vessels were going to participate in the fishery each year. This could lead to a total catch that did not equal the target.

Compared to Alternative #10, in what ways might this Alternative have a more positive effect on red crabs?

Individual vessel quotas, which sum to the TAC, are easy to track and enforce. Reporting requirements will also support this. Thus, the realized landings will be very close to the TAC. With individual quotas, vessels are less likely to harvest in the manner of a fishing derby. This could reduce the risk that the fishery would disturb the red crab mating process. Incidental catch limits will prevent excessive red crab landings by vessels from other fisheries. Gear restrictions may allow small red crabs to escape from traps. Reporting requirements for each trip will allow total landings to be monitored.

Compared to Alternative #10, in what ways might this Alternative have a more

negative effect on red crabs?

There are no conditions under which this alternative would be expected to have more negative effects on red crabs than Alternative 10.

5.4.10.2 Ecological Impacts of the Alternative on Other Species and Communities

There are no expected differences in the ecological impacts on other species or their communities between this management alternative and the first baseline, Alternative 1, the emergency action alternative. The only difference in the ecological impacts on other species or their communities expected between this management alternative and the second baseline, Alternative 10, the no action alternative, is that associated with the prohibition on all fishing gear types other than traps in the directed red crab fishery, which would be expected to confer benefits to other species and their communities by preventing the use of mobile gear such as otter trawls and dredges.

5.4.10.3 Impacts of the Alternative to Essential Fish Habitat

The relative impacts to essential fish habitat (EFH) of each management alternative under consideration are compared against those of two baselines: Alternative 1, the emergency action alternative, and Alternative 10, the no action alternative.

The only management measures under consideration with any potential relevance to impacts to the EFH of any managed species that may be associated with the directed red crab fishery are the proposed trap limits and the proposed gear restrictions. Both of these measures would be proposed in the first baseline, Alternative 1, the emergency action alternative, but only the gear restrictions are proposed in this alternative. Due to the nature of the proposed IVQ system, there is no need to implement any type of trap limit in the red crab fishery. This difference could result in an increase in the number of traps employed in the fishery under this alternative compared to the number of traps that would be employed if trip limits were also implemented. Thus, from the perspective of potential impacts to EFH, this alternative would be expected to have potentially more impact than the first baseline.

The no action alternative, Alternative 10, by definition would not include any type of trap limit or gear restrictions. Because it proposes to implement some form of gear restrictions, including a prohibition on the use of non-trap gear in the directed red crab fishery, this alternative is less likely to result in any impacts to EFH than is the no action alternative. This alternative is expected to have a more positive effect on the EFH of managed species than would the second baseline.

5.4.10.4 Economic Impacts of the Alternative on the Fishery

This alternative is very similar to the previous alternative, except that it would rely entirely upon an individual vessel quota system to control the harvest of red crabs in the directed red crab fishery. Any vessel with a history of red crab landings prior to the implementation of the FMP would be able to continue fishing for red crab, albeit at the same relative rate at which they previously fished.

The composition of the fleet would remain as it is now. Without controlled access, a greater number of vessels would be participating in the fishery, but because of this, each vessel would have a lesser quota than the previous alternative. It would not preclude any vessel now operating in the fishery from participating but would still provide an upper limit on the quantity of labor and capital in the fishery.

With individual quotas, vessels are less likely to harvest in the manner of a fishing derby. Trip revenue would increase as there would be no limits on the amount of crab landed per trip. Vessels could operate to their full potential and utilize their hold capacity. This alternative would shift a substantial part of the management to a market mechanism, since it eliminates some of the gear, vessels, and processing restrictions that are a greater burden to enforce. This alternative should encourage technological development and innovation. Vessels participating in the directed fishery would have the freedom to choose the most appropriate fishing methods (aside from gear restrictions), fishing times, and strategies.

There are a couple of potential negative economic impacts. High-grading could be a problem, although this would be expected to be minimal given the market constraints that already exist in the fishery. Second, the creation of use rights means that some gain and some lose; this creates a redistribution of wealth and has equity implications.

This alternative should encourage technological development and innovation. Vessels participating in the fishery would have the freedom to choose the most appropriate fishing methods (aside from gear restrictions), fishing times, and strategies. Data would be gathered which would enable future management actions to use more comprehensive, reliable, and timely information on the fishery.

5.4.10.5 Social/Cultural Impacts of the Alternative

Compared to Alternative 1, in what ways might this alternative have a more positive social/cultural impact?

The positive effects of this alternative compared to Alternative 1 are the same as for Alternative 8, with the exception of those benefits associated with controlled access.

Compared to Alternative 1, in what ways might this alternative have a more negative social/cultural impact?

There are no conditions under which Alternative 9 would be expected to have more negative social or cultural impacts than Alternative 1.

Compared to Alternative 10, in what ways might this alternative have a more positive social/cultural impact?

The positive effects of this alternative compared to Alternative 10 are the same as for Alternative 8, with the exception of those benefits associated with a controlled access system.

Compared to Alternative 10, in what ways might this alternative have a more negative social/cultural impact?

There are no conditions under which Alternative 9 would be expected to have more negative social or cultural impacts than Alternative 10.

5.4.10.6 Impacts of the Alternative on Protected Species

IVQs will not provide adequate control on the growth of the fishery and may result in more fixed gear being set in high use waters for protected species. Although a TAC will control the amount of landings, the amount of gear allowed to be used will not be controlled, nor is the timing of the gear controlled during the spring high use of the continental shelf edge by endangered large whales and leatherback sea turtles. Incidental catch limits will serve to limit growth of non-directed red crab fisheries such as offshore lobster along the continental shelf edge. The reporting requirements will provide information regarding the seasonal and spatial distribution of red crab fishing effort to allow managers to better assess the actual overlap of the fishery with protected species. The gear requirements proposed would not provide any additional protection beyond what is already provided under the MMPA regulations that implement the ALWTRP.

IVQs will not provide adequate control on the growth of the fishery and may result in more fixed gear being set in high use waters for protected species, namely the endangered sperm whale and other odontocetes protected under the MMPA; as well as migratory or occasional foraging habitat for the endangered right, humpback, fin, blue and sei whales and the endangered leatherback sea turtle. Since the level of TAC to be applied to the IVQ system has not yet been chosen, we cannot assess the protected species effects with respect to Alternative 1. However, the fact that an unlimited number of vessels may participate in the fishery will likely result in an increase in the amount gear that will be used over Alternative 1, although it may be less than the complete lack of effort under Alternative 10.

5.4.11 Alternative 10: No Action

This non-preferred alternative proposed to implement no management measures for the red crab fishery. With no management measures, Alternative 10 represents an unregulated fishery. It does not have the six management measures in Alternative 1 (incidental catch limits, trap limits, gear requirements, total allowable catch, trip limits and reporting requirements).

5.4.11.1 Biological and Ecological Impacts of the Alternative on Red Crab

Compared to Alternative #1, in what ways might this Alternative have a more positive effect on red crabs?

There are no conditions under which this alternative would have a more positive effect on red crabs than Alternative 1, or any of the other alternatives.

Compared to Alternative #1, in what ways might this Alternative have a more

negative effect on red crabs?

Under this alternative, incidental catch would not be regulated and could cause significant red crab mortality. With no restrictions on number of traps or type of gear, the stock could easily be overfished given the power of the red crab fleet. With no restrictions on total allowable catch, trip limits, or reporting requirements, the stock could easily be overfished and it would not be possible to monitor accurately the degree of overfishing. Without some form of management program in this fishery, the resource will be subject to overfishing and could be rapidly depleted.

5.4.11.2 Ecological Impacts of the Alternative on Other Species and Communities

There are no conditions under which this alternative would have a more positive ecological effect on other species and their associated communities than Alternative 1, or any of the other alternatives. Without some form of management program for this fishery, uncontrolled and potentially escalating fishing effort for red crabs could have negative ecological impacts on other species and their communities.

5.4.11.3 Impacts of the Alternative to Essential Fish Habitat

There are no conditions under which this alternative would have a more positive effect on the EFH of any Federally-managed species than Alternative 1, or any of the other alternatives. Without some form of management program for this fishery, such as the trap limits proposed in Alternative 1 and the gear restrictions and controlled access system proposed in the other alternatives, uncontrolled and potentially escalating fishing effort for red crabs could have adverse impacts on some areas designated as EFH for Federally-managed species.

5.4.11.4 Economic Impacts of the Alternative on the Fishery

Alternative 10 would have the greatest economic impact of all alternatives. The no action alternative is one of the baselines against which all other alternatives actions are compared. This can be defined as what is likely to occur in the absence of any of the proposed actions. We will attempt to assess the incremental economic effects relative to this baseline.

With no restrictions, additional entrants would be allowed into the fishery; based on recent occurrences, this would be expected to occur. In the short term, landings may increase, but because they are not sustainable, the long term economic effect will be negative. Since there are no biological projections for landings or LPUE available for any of the alternatives, it is impossible to estimate quantitatively the magnitude of the expected change in revenue that would occur. With the entry of additional vessels, and vessels of increasing size, the catch per vessel would decrease. Historic participants could be eliminated from the fishery or at least become marginally viable.

With no action, the most likely outcome would be that overfishing will occur and a future FMP would need to implement measures that would end and prevent future overfishing. Worse, if appropriate exploitation rates are greatly exceeded or, if it is

determined that the red crab stock is overfished, the FMP will need to include a number of restrictive measures to eliminate overfishing and/or rebuild the resource under a statutory time schedule. Therefore, the no-action alternative would likely reduce long-term economic benefits to the fishery. Depending on the amount of fishing that would occur in the absence of any action, a future FMP may have to be more restrictive in order to effectively manage the stock.

In the absence of regulation, there would be an increased supply of red crabs to consumers initially, but the long term effect would be decreased supply and presumably higher prices. In the same manner, an initial increase in processing requirements may occur, depending on the quantity that is processed at sea and the quantity that is processed on shore. Since most of the red crab product is processed, increased supply may not have as large of an effect on price, since processed products have a longer shelf life and are not perishable. A demand equation to determine the impacts of supply on the market cannot be estimated at this time.

In the absence of regulation, there would likely continue to be significant under-reporting, since there would be no incentive for the vessels or dealers to report their landings. Also, the uncontrolled and potentially escalating effort could have negative economic impacts on those businesses who depend on the red crab fishery.

5.4.11.5 Social/Cultural Impacts of the Alternative

There are no conditions under which this alternative would have a more positive social and/or cultural effect on the red crab fishery than Alternative 1, or any of the other alternatives. Without some form of management program for this fishery, such as the trap limits proposed in Alternative 1 and the effort controls and controlled access system proposed in the other alternatives, uncontrolled and potentially escalating fishing effort for red crabs could have negative social and/or cultural impacts on the current members of the red crab fishery and those that depend upon them.

5.4.11.6 Impacts of the Alternative on Protected Species

Alternative 10 will not provide adequate control on the growth of the fishery that would result in more fixed gear being set in high use waters for protected species, namely the endangered sperm whale and other odontocetes protected under the MMPA; as well as migratory or occasional foraging habitat for the endangered right, humpback, fin, blue and sei whales and the endangered leatherback sea turtle. The amount of gear allowed to be used would not be controlled, nor would the timing of the gear be controlled during the spring high use of the continental shelf edge by endangered large whales and the leatherback sea turtle. Non-directed red crab fisheries such as offshore lobster could also expand along the continental shelf edge to harvest red crab. There would be no reporting requirement to provide additional information regarding the seasonal and area distribution of red crab fishing effort.

	Management Alternatives									
	Emergency Rule	Hard TAC and Trap Limits	Hard TAC, Trap and Trip Limits	Target TAC with DAS	Target TAC with DAS & Trip Limits	Trip Limits with # of Trips	All Possible Measures	IVQ with Controlled Access	IVQ Only	No Action
Economic elements¹⁸	1	2	3	4	5	6	7	8	9	10
Harvest level										
Employment										
Price										
Revenue										
Vessel efficiency				+					+	+
Fishing season length		0	0	+	+	0	0	+	+	
Industry output level										
Harvesting/processing costs										
Fleet size		+	+	+	+	+	+	+	0	0
Fleet composition										
Management costs, difficulty		-	-			-	-			+

Table 23: Expected economic impacts of all alternatives compared to Alternative 1 (emergency rule).

¹⁸ Economic impacts include market effects, profit effects, and fleet effect; They are rated positive (+), negative (-), neutral (0). Empty cells represent unknown effects or direction of change from baseline.

	Management Alternatives									
	Emergency Rule	Hard TAC and Trap Limits	Hard TAC, Trap and Trip Limits	Target TAC with DAS	Target TAC with DAS & Trip Limits	Trip Limits with # of Trips	All Possible Measures	IVQ with Controlled Access	IVQ Only	No Action
Economic elements¹⁹	1	2	3	4	5	6	7	8	9	10
Harvest level	+	+	+	+	+	+	+	+	+	No Action Alternative
Employment										
Price										
Revenue ²⁰	+	+	+	+	+	+	+	+	+	
Vessel efficiency	-	-	-	+		-	-	+	+	
Fishing season length	-	-	-	+	+	-	-	+	+	
Industry output level										
Harvesting/processing costs								+	+	
Fleet size	0	+	+	+	+	+	+	+	0	
Fleet composition										
Management costs, difficulty	-	-	--	-	-	-	--	-	-	

Table 24: Expected economic impacts of all alternatives compared to Alternative 10 (no action).

¹⁹ Economic impacts include market effects, profit effects, and fleet effect; They are rated positive (+), negative (-), neutral (0). Empty cells represent unknown effects or direction of change from baseline.

²⁰ Assumes prices are held constant